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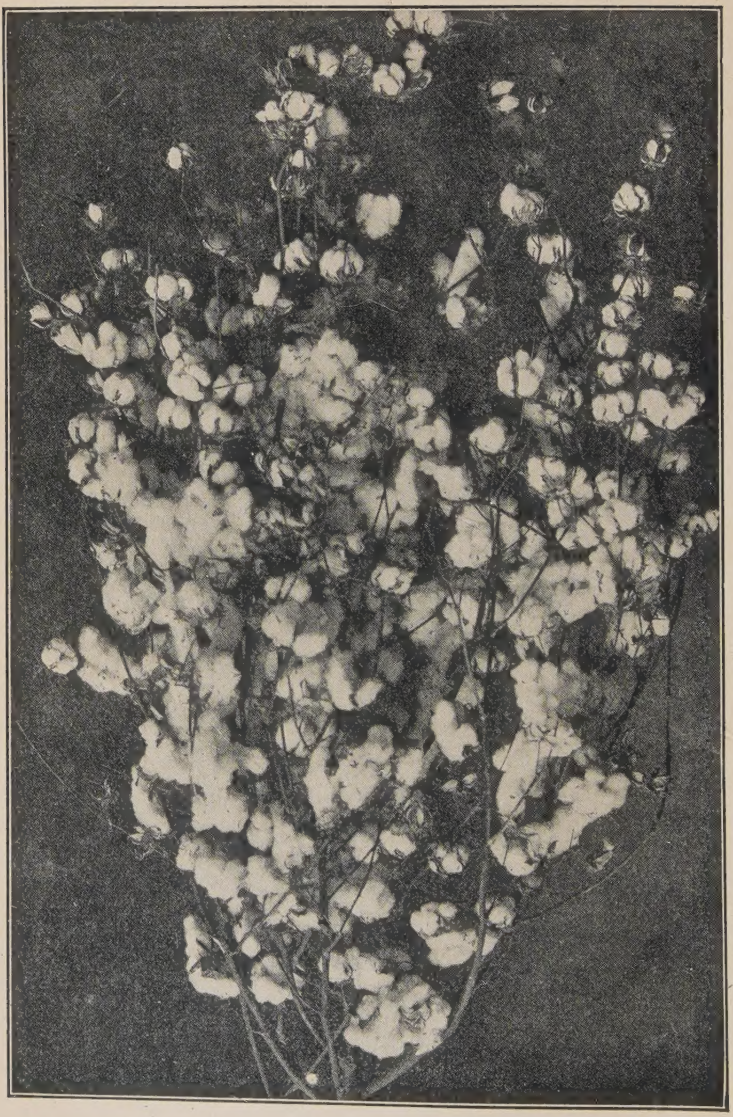

COTTON PLANT

TEXTILES

FOR COMMERCIAL, INDUSTRIAL, AND DOMESTIC ARTS SCHOOLS; ALSO ADAPTED TO THOSE ENGAGED IN WHOLESALE AND RETAIL DRY GOODS, WOOL, COTTON, AND DRESSMAKER'S TRADES

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REVISED AND ENLARGED
WITH EXPERIMENTS

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PREFACE

The author has had considerable experience during the last fifteen years in organizing and conducting textile and technical schools of secondary grade. At an early date he recognized the need of special textbooks to meet the demands of young people who are attending these schools in order to enable them to solve everyday problems. There are plenty of books written on textiles for advanced workers in the productive branches of the industry, but the author has failed to find suitable textbooks adapted to the needs of beginners and including the artistic aspects and distributive methods of textiles. This book is written to meet this educational need. Others may find the book of interest, particularly experienced salespeople who feel the need of a knowledge of textiles expressed in selling points.

The author is under obligation to the following for permission to use cuts and information: Mr. Franklin W. Hobbs, Arlington Mills; Mr. S. H. Ditchett, Editor *Dry Goods Economist* and *Dry Goods Encyclopedia;* Mr. Frank P. Bennett; *Wool and Cotton Reporter;* Butterick Pattern Co.; Marshall Field Co. (Cretonne Department); M. C. D. Crawford, Design Editor, *Women's Wear;* Cheney Bros.; and Schumacher Co.

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SUGGESTIONS TO TEACHERS

The subject of textiles is included in the course of study of the domestic art and commercial and salesmanship departments because it gives the technical knowledge concerning fabrics, clothing, etc., necessary for intelligent progress and the highest success in the working, understanding, and appreciation of fabrics.

The subject may appear to be extremely difficult to teach because it is based upon certain technical operations and properties of fibers that have never before come to the attention of the student. It may seem, at times, to be uninteresting and hard to understand, even when the student realizes its importance. But if the student is given an opportunity to handle the materials and to perform the experiments and projects, he will obtain a background of experience that will serve as an apperceptive basis for the technical details. Then the seeming difficulties of the subject of textiles will become clear and simple. (See Experiments and Projects in the Appendix.)

There are two distinct methods of presenting the subject, which for want of better names, we will call the *logical* and the *psychological*. The logical method is the one found in most textbooks and is used by the majority of teachers. It begins with the study of the individual fiber, followed by the manufacture of yarn from the fiber, and of the cloth from the yarn. It is a method that may be used with some degree of success with evening classes located in mill centers, the aim of the course being to prepare students directly for the mill, where they come in contact with the fibers and yarns. It fails, however, to give the best results to beginners who desire a knowledge of the different kinds and qualities of fabrics, such as is required by dressmakers and salespeople. It does not begin with the proper point of contact, that is, the object that the student sees. He knows and sees cloth, but he does not know and see the individual fiber.

The psychological method seems better adapted to high school students, because it starts with the finished cloth, with which we all are familiar, and works back to the constituents of the fabric — yarn, warp, and filling. The emphasis in this method is laid on the finished textile and design, and on only that part of the manufacturing operations and properties of raw material that influence the uses, qualities, and grades of the finished product.

To illustrate: A class of high school girls in dressmaking are working on a piece of muslin. They should know about the different kinds of muslin. Let them examine the cloth by holding it up to the light. Ravel the fiber and notice how it is made. Since the threads run at right angles, this material is called a woven fabric and consists of warp threads and filling threads.

The closeness of the threads determines the fineness of the fabric. In purchasing a cotton fabric we should choose one with the largest number of threads to the inch, provided the price is within the limit that we can pay. Examine different grades of cotton fabric and note that the strongest are those having the threads close together. Untwist the thread and notice that it is composed of twisted short lengths called fibers. The twist gives strength to the thread, and the thread, in turn, gives strength to the cloth. The longer the fiber the more twist can be given to the thread. Hence, the strength of the cloth depends upon (1) the closeness of the threads in the cloth, and (2) the length of the fiber.

Therefore a knowledge of cotton cloth depends upon a knowledge of how threads, called yarns, are made, the properties of the individual fibers, and the manufacturing operations in so far as they affect the fiber with regard to cleanliness, smoothness, etc.

The aim and purpose of a course of study determine the content of the information to be imparted and the method of instruction. To illustrate: A course in textiles for mill men should embrace: (*a*) the physical properties of the raw material which make it adaptable to many fabrics; (*b*) machine repair; (*c*) the mechanism of the machines and operations used in producing the finished cloth.

A course of study in wholesale and retail selling, on the other hand, should train students in the characteristics and uses of the finished fabrics in order to increase their sale, that is, more rapid distribution from mill to consumer. A knowledge of the characteristics and uses of

fabrics may be used as selling points in dealing with the public. This course should include: (*a*) structure of fabrics; (*b*) finishes of fabrics; (*c*) raw materials in so far as they contribute to the finished structure.

A course of study in textiles for the needle trade should include such topics as will enable one to judge the value of cloth for various articles of clothing.

Courses in decorative fabrics should include: (*a*) characteristics; (*b*) grades; (*c*) uses; (*d*) defects; (*e*) period decorations; (*f*) selling points.

Suggestive Outline for Dressmaking Courses in Textiles

A. Show the value of a knowledge of textiles.

B. Begin with the simple structure of fabrics by examining pieces of cloth that are familiar to the student, as follows:

a. Serge — woven fabric

b. Tricolette — knitted fabric

c. Crochet — plaited fabric

d. Felt — felted fabric

C. Ravel each of the above fabrics and show:

a. Woven fabric is composed of two sets of yarn interlacing at right angles.

b. Knitted fabric like tricolette is composed of a single yarn interlacing itself in a circle or a straight line.

c. Plaited fabric is composed of a single yarn interlaced freely so as to make designs, as in lace work.

d. Felted fabric is composed of small fibers pressed together.

D. Characteristics or selling points of the above:

a. Woven fabric — strong, rigid, etc.

b. Knitted fabric — easily made, elastic, goes to pieces quickly when torn.

c. Plaited fabric — beautiful geometrical designs in open work.

d. Felted fabric — any thickness or weight, waterproof, etc.

E. Constituents of a woven fabric:

a. Warp slightly stronger than filling.

b. Filling — less twist than warp.

F. Constituents of yarn:

a. Ply.

b. Twist — hard, medium, soft.

G. Since fabrics are made of twisted fibers interlaced, we must study the raw materials — the characteristics of the fibers that make the fabrics attractive and useful.

1. Fibers used in the fabrics treated in this course of study:
   - *a.* Cotton
     - (1) Growth
     - (2) Properties
     - (3) How marketed
     - (4) Grades and uses
   - *b.* Wool
     1, 2, 3, 4, as above
   - *c.* Silk
     1, 2, 3, 4, as above
   - *d.* Linen
     1, 2, 3, 4, as above
   - *e.* Jute
     1, 2, 3, 4, as above
2. Manufacture of yarn:
   - *a.* Different manufacturing processes
   - *b.* Counts of yarn
   - *c.* Twist, etc.
3. Different kinds of weaves — their structure and value:
   - *a.* Plain — example, muslin
   - *b.* Twill — serge
   - *c.* Sateen — satin
   - *d.* Jacquard — brocade
   - *e.* Doublecloth — ulster overcoating
   - *f.* Pile — velvet, plush
   - *g.* Gauze — marquisette
   - *h.* Lappet — dotted swiss
4. Dyeing and printing:
   - *a.* Piece
   - *b.* Yarn
   - *c.* Raw stock

   } use

   1. Block
   2. Blotch
   3. Resist
   4. Extract
   5. Combination
   6. Batik
5. Finishing:
   - *a.* Bleaching, etc.
   - *b.* Napping
   - *c.* Sizing
   - *d.* Pressing
   - *e.* Waterproofing

There are two methods of imparting instruction: the lecture method and the development method.

The lecture method is adopted when it is desired to impart information quickly. The teacher reads or dictates notes. This method is effective, provided the students have background or experience that will serve as an apperceptive basis; that is, a fund of practical experience that will furnish a foundation for the information of the lecture. The lecture method may be used with some degree of success in colleges where students are mature and able to understand principles in the abstract, to discuss them freely, and to form judgments or conclusions. It may also be used to some extent with salesmen in evening trade classes, but as a rule the lecture method, by itself, is not very effective in teaching textiles or any other technical subject to beginners who have had no practical experience.

Despite the above objections, most teachers use the lecture method. It is a safe rule for a teacher not to talk more than 20 per cent of the time. When a teacher talks or lectures more than ten or fifteen minutes, the students fail to hold the thread of reasoning or thought, and soon lose interest. Then there is a tendency for the mind to wander and breaches of discipline take place.

The development method is supplemented by the laboratory or by objective teaching, and is the most effective method of teaching textiles or any other technical subject. This method begins with the experience of the student, adding new knowledge to the old. The teacher begins by asking brief questions that will recall to the student's mind all the information that he has on the subject. To illustrate: Give each student pieces of cotton cloth in the grey and bleached and ask such questions as these:

1. What is the natural color of cotton?
2. What is the objection to this color? *Ans.* It does not look clean.
3. How can the color be changed? *Ans.* By bleaching.
4. For what is cotton used? *Ans.* For making cloth.
5. Can cotton cloth be washed? *Ans.* Yes.
6. How can it be made to look like new? *Ans.* By washing, starching, and ironing.
7. Is it soft? *Ans.* Yes, when it is wet, or when the starch has been removed.
8. Can it be made stiff or hard? *Ans.* Yes, by starching. Example, collars.

9. Does it burn? *Ans.* Yes, without odor.
10. Where does cotton come from? *Ans.* A plant — vegetable.

The answers are summarized on the blackboard and supplemented by drill questions pertaining to the applications of the subject matter. This method, under the guidance of the questions of the teacher, encourages the student and develops the information from observation and reasoning.

Instructors should apportion the time allowed so that each subdivision of the subject may receive due consideration. This may be done in the Plan and Progress Book which each teacher should keep in his desk so that it may be consulted by substitutes or supervisors.

The work for each day should be carefully arranged according to the following plan:

Purpose of the Lesson

1. *Preparatory Period.* Use various means to arouse interest, so that students will see that the lesson is worth while. Recall the student's previous experience relating to the purpose of the lesson.

2. *Presentation.* After the student's mind has been aroused, and he has previous experience or education before him, present the principles of the lesson in concrete form. The instruction should be based upon objective teaching: samples of cloth, samples of raw materials, demonstration. Use illustrative materials.

3. *Inspection or Test Period.* This step should consist of questions arranged in progressive order to provoke thinking and reasoning power. Then the answers to the questions may be summarized, followed by drill questions or problems to test the student's knowledge of the subject.

4. *Dismissal Period.* Collection of materials, machines, parts, or tools, placed in order.

In many needlework courses the syllabus may not provide for definite time allotment for the study of textiles. In that case, textiles may be taught as part of the related technical knowledge of sewing. That is, teach the principles of the different fabrics and threads used in the sewing classes. The interest in presenting the subject in this informal manner may be greater than that obtained in the regular organized course presented as a formal subject. When the subject is taught in the informal method different sections

of the text may be assigned for reading and home study as suggested by the following outline:

(*a*) Study of the different staple fabrics
(*b*) Use of each fabric
(*c*) Width
(*d*) Weight
(*e*) Weave
(*f*) Yarn
(*g*) Staple
(*h*) Dye
(*i*) Finish
(*j*) Weaving qualities

Each student should be encouraged to keep a notebook. Students should be told in advance what fabrics are to be discussed in the next lesson, and they should have at least one or two small samples. These samples should be studied by the student, with the teacher, in the following manner:

a. Finish
b. Weave
c. Material { Warp / Filling
d. Yarn
e. Staple
f. Uses
g. Adulteration and novelty
h. Defects

The samples should be pasted in the student's notebook, and notes written after them. Instructors should check their own work by giving frequent oral and written examinations. In this way any weak points may be detected and the teacher may see how successfully he has presented the subject.

TEXTILES

CHAPTER I

VALUE OF FIBERS

Textiles. Textiles is a term used to denote the raw and finished materials made from cotton, wool, silk, linen, and other fibers. It includes practically all the materials used in the clothing of the human race, in addition to floor and wall coverings, some furniture coverings, and interior decorations. Since the clothing of the human race is the most important of all industries (excluding the feeding of the race), it follows that the study of the art of production, distribution, and consumption of textiles is worth while, since it concerns all directly or indirectly.

Fibers. Examine a piece of cloth. Notice that it is made by the interlacing of the threads. Ravel a thread of the cloth and untwist it. See that it is composed of twisted lengths called fibers or that the fibers are pressed together forming a cloth called felt. All the materials used in the manufacture of clothing are called *textiles* and are made of either long or short fibers. These fibers can be made into a continuous thread. When two different sets of threads are interlaced, the resulting product is called *cloth.*

Properties of Fibers. The value of any fabric depends primarily upon the individual fibers that compose it. The characteristics of the fiber make the characteristics of the cloth. Therefore, the first thing we should know about a fabric is the nature of the individual fibers. Some fibers cannot be made into cloth. Hair, for example, cannot be spun and woven. It is too smooth, and cannot be drawn out and twisted like wool or cotton.

The value of any fiber for textile purposes depends upon the possession of such qualities as power of absorbing moisture, reaction to cleansing agents, ability to conduct heat, fineness of luster, structure, affinity for dyestuffs, feel and beauty, felting, length, curl, softness, elasticity, etc., which adapt it for drawing out and twisting (called carding and spinning, or felting), and for other purposes that are useful for clothing.

A knowledge of the special characteristics of the various classes of textiles is very useful to one engaged in buying or selling textile products, as these qualities supply helpful selling points to the salesman. Such a knowledge is also of great value to one engaged in utilizing textiles for manufacturing purposes. All manufacturing operations must be based upon the adaptability of the fibers and cloth.

Fineness is the quality some fibers have of being very small in diameter and exceptional in length, making them capable of being spun into fine thread or yarn. Silk is very fine, because it possesses these characteristics. *Structure* is the formation of the fiber. Some fibers, like those of wool, have a very scaly formation and can be used for heavy, fuzzy fabrics. Silk and wool attract dye-

stuffs more strongly than cotton and linen; hence, silk and wool fabrics are said to be *faster* than jute, cotton, and linen fabrics. *Feel* is the term used to express the sensation one receives on touching a fiber or fabric. Some fabrics, like silk velvets, have a better feel than other fabrics. *Luster* is the power a fiber or fabric has of reflecting light. Some fibers, like silk, resemble glass and have high reflecting power, while cotton is porous and does not reflect light very much. Silk ranks far above cotton in luster. *Beauty* is the pleasant sensation one receives from looking at a fabric, and it is due to those qualities of fabrics that appeal to the eye. Silk has greater beauty than cotton. *Felting* is the power a fiber or fabric of wool has of contracting when exposed to heat, friction, moisture, and soap.

Firmness is the ability to resist being crushed under pressure. For example, a fiber that is easily crushed or distorted is not serviceable. A fiber must be over a half-inch long in order to be spun into yarn. Certain fibers, like forms of kapok, would be very desirable for cloth if they were not too short for spinning. *Curl* is the natural ability of the fiber to assume beautiful wavy positions. Certain wools are naturally curly and can be used in making artificial fur or curly overcoating. *Softness* is the property of a fiber that yields to pressure. Lambs' wool is especially soft. *Elasticity* is the power of a fiber, when pulled, to return to its original position. It is very desirable that fibers should be elastic so as to conform to the shape of the body. Silk is more elastic than cotton, hence silk hosiery clings to the ankle better than cotton.

Absorption means the power to hold moisture and to give it off gradually. Linen has greater absorbing power than cotton; therefore linen makes a better towel than cotton. The ability of a fabric, like cotton, to withstand the action of soap, water, and friction is very important. Cotton, for example, is very useful because it can be easily cleaned. Some fabrics, like linen, feel cool to the touch because they allow the heat to pass from the body, hence the cool sensation. On the other hand, some fibers, like wool and silk, feel warm to the touch because they do not readily conduct the heat from the body.

Commercial Fibers. The number of fibers that possess these qualities is small, and they may be classified as follows:

Animal Fibers. Wool, silk, mohair.

Vegetable Fibers. Cotton, flax, jute, ramie, hemp, kapok, etc.

Mineral Fibers. Asbestos, tinsel, and other metallic fibers.

Remanufactured Material. Noils, mungo, shoddy, extract, and flocks.

Artificial Fibers. Spun glass, artificial silk, and slag wool.

While there are thousands of other fibers, particularly vegetable, (like pineapple fiber), and the fibers of spiders and caterpillars, that might be used, they do not possess commercial value, that is, either the supply is limited, or the cost of raising the fibers, or the cost of cleaning is beyond the price the consumer can afford to pay. For these reasons the fibers named in the lists above are the only ones that have distinct commercial value.

QUESTIONS

1. What is meant by the term " textile "?
2. Why is the subject of textiles important?
3. What are the two fundamental industries?
4. What is the difference between producing and distributing textiles?
5. What is meant by " consumption "? Are you a consumer of textiles? Why?
6. What is a fiber?

7. Why is it necessary to know about the individual parts of a piece of cloth or fabric?

8. Would it be possible to know the qualities of a fabric without knowing the individual characteristics of the fibers?

9. Of what is cloth composed?

10. Is it possible to have all cloths made of the same fibers? If not, why not?

11. Name some of the fibers used in making textiles.

12. Divide them into classes according to origin: animal, vegetable, mineral, artificial fibers, remanufactured material.

13. Describe the following properties of fibers: curl, felting, luster.

14. What are the qualities necessary to give a fiber commercial value?

15. Name the chief commercial fibers that are on the market.

16. Make a list of the characteristics of fibers, and explain the meaning of each one with examples.

CHAPTER II

WOOL

History. A large part of the people of the world have always used wool for their clothing. *Wool* is the soft, curly covering which forms the fleecy coat of the sheep and similar animals, such as the goat and alpaca.

WOOL FIBER
Highly magnified

Characteristics of Wool. The chief characteristic of wool is its *felting* or *shrinking power*. This felting property, from which wool derives much of its value and which is its special distinction from hair, depends in part upon the kinks in the fiber, but mainly upon the scales with which the fiber is covered. These scales or points are exceedingly minute, ranging from about 1100 to the inch to nearly 3000. The stem of the fiber itself is extremely slender, being less than one thousandth of an inch in diameter. In good felting wools the scales are more perfect and numerous, while inferior wools generally possess fewer serrations, and are less perfect in structure.

Wool fiber when viewed under the microscope is seen to consist roughly of three parts:

1st. Epidermis, or outer surface, which is a series of scales lying one upon the other.

2d. Cortex, or intermediate substance, consisting of angular, elongated cells, which give strength to the wool.

3d. Medulla, or pith of the fiber.

The tensile strength of a wool fiber is low, its elasticity is high. The length of the fiber varies from one inch to over ten, and the diameter from .0018 to .004 of an inch. The better a wool is, the less it is like hair. Generally speaking, the finer the wool, the shorter the fiber, but length alone does not indicate the grade. Pure Merino and high cross-bred wools have a close wave, known as crimp, which increases the elasticity and is therefore desirable from a spinning standpoint.

The chemical composition of wool is: carbon 50%, hydrogen 7%, nitrogen 18%, oxygen 22%, and sulphur 3%. It is soluble in alkalies, and at a temperature of 130°C. will reduce to powder.

Difference between Wool and Hair. Not all animal fibers are alike. They vary in fineness, softness, length, and strength, from the finest wool to the rigid bristles of the wild boar. At just what point it can be said that the animal fiber ceases to be wool and becomes hair is difficult to determine, because there is a gradual and imperceptible gradation from wool to hair.[1] The distinction between wool and hair lies chiefly in the great fineness, softness, and wavy delicacy of the wool

[1] Hair is straight and glossy, stronger and smoother than wool, and grows sometimes as long as twenty inches.

fiber, combined with its highly serrated surface — upon which the luster of the wool depends.

In the process of felting the fibers become entangled with one another, and the little projecting scales hook into one another and hold the fibers closely interlocked. The deeper these scales fit into one another, the closer becomes the structure of the thread.

Breeds of Sheep. The date at which prehistoric man discarded pelts or skins as a source of clothing and began to use a woven fabric of wool marks the origin of the textile industry. Primitive sheep were raised for food and were covered with hair, and the wool which now characterizes them was then a downy undercoat. When men gained a better knowledge of the care of sheep and of the value of wool, hair gradually disappeared from the sheep, the food value of sheep decreased, and the wool value increased. That is, the hairy flocks were bred out, and the sheep with true wool, called the *Merino*, survived. These sheep were bred by the nobility principally for the wool and not for the mutton. The fleece of this breed is *fine*, *strong*, *elastic*, and of good color; it also possesses a high felting power. Though naturally short, it is now grown to good length and the fleece is dense.

The Merino sheep is a native of Spain, and Spain was for a long period the chief country of its production. It was later introduced into Saxony and was highly bred there, and Saxony soon came to surpass Spanish wool in fineness, softness, and felting properties. The Merino was introduced into the United States at the beginning of the nineteenth century. By 1810, 5000 Merino

sheep had been imported, and these 5000 sheep formed the basis of most of the fine wool-producing flocks of our country to-day.

During the eighteenth century various European countries began to develop the wool industry. In order to increase the value of the wool, they imported Merino sheep and crossed them with their native breeds which were raised primarily for mutton. This frequently produced excellent results. In 1810 Merinos were first introduced into Australia with astonishing results both as to grade of wool and increase of flocks. About the same time South America and South Africa imported Spanish sheep. Of all the highly civilized countries, England is the only one where Merino breeding was not successful. This was due in part to the climate, but the chief cause was the fact that British sheep-raising was primarily for mutton, and only secondarily for wool. The Merino types are smaller, and hence do not yield as good mutton carcasses as some of the native "Down" and "Mountain" breeds. In many cases, however, the native English breeds, notably the Lincoln, have been imported by other countries and then crossed with Merinos with very good success.

Our own climate is highly favorable for sheep breeding, and it is certain that the American sheep has no superior in any wool growing country, in constitutional vigor and strength of wool-fiber, and no wools make more durable or more valuable clothing.

The obstacles to sheep husbandry in certain parts of the United States, like New England, are mainly climatic. The natural home of the only races of sheep which can be herded in large flocks is an elevated tableland, like the steppes of Russia and the great plains of Asia, Argentina, Montana, Wyoming, and others of our western states where an open air range is possible for nearly twelve months in the year. In these elevated lands there are grasses which are more nutritious in winter than in summer. The climate of New England does not permit the growth of such grasses. Every grass which will grow in New England becomes in the cold months frozen wood fiber. Then again there is the frigid and penetrating atmosphere which necessitates housing the sheep in winter, and these animals cannot be closely housed without engendering a variety of parasitic diseases.

Classification of Wool. The various kinds of wool used in commerce are named either from the breed of the sheep or from the country or locality in which the sheep are raised. Thus we get Merino wool from Merino sheep, while English, American, and Australian wools are named from their respective countries. As the result of cross-breeding of different sheep in different parts of the world, under different climatic conditions, physical surroundings, and soil, there exist a great many varieties of wool.

American Sheep. Originally there were two kinds of sheep: One raised by the nobility for the fine wool, called Merino, small in size, with poor quality of flesh for mutton, and the other developed for size — mutton — and having coarse wool. Since the farmer depends for his profit on the sale of his lambs, there has been a tendency to develop a type of sheep good in both mutton and wool. This type is called *cross bred* sheep.

The fineness of wool is expressed in terms of the Merino standard. The terms half blood, three eighths blood, and quarter blood refer to the full-blooded Merino standard. As the scale descends the wool becomes coarser, the wool of a quarter blood usually being a comparatively coarse fiber.

American sheep breeding has been confined to these two types — *Merinos* and *cross breds*. Since most of the wools — two thirds — come from west of Missouri and are quarter-blood or better, they are known in the trade as *territory* wools. The wools grown in the

eastern half of the United States on farms are called *fleece* wools. The wools grown in Ohio, Pennsylvania, and Michigan approximate very closely the Australian wools in fineness and felting properties, and are known as *domestic* wools.

Another method of classification is to divide the wool of commerce into three great classes: (1) Short wool or clothing wool (also called carding wool), seldom exceeding a length of two to four inches; (2) long wool or combing wool, varying from four to ten inches; (3) carpet and knitting wool, which is long, strong, and very coarse.

The distinction between clothing or carding wools on the one hand, and combing wools on the other, is an old one. Combing wools are so called because they are prepared for spinning [1] into yarn by the process of "combing" — that is, the fibers are made to lie parallel with one another preparatory to being spun into thread. Carding wools — made to cross and interlace and interlock with one another — are shorter than combing wools, and in addition they possess to a much greater degree the power of felting — that is, of matting together in a close, compact mass. Combing wools, on the other hand, are not only longer than the carding wools, but they are also harder, more wiry, and less inclined to be spiral or kinky. It must be understood, however, that under the present methods of manufacture, short wools may be combed and spun by the French method of

[1] Spinning is a process by which long or short fibers are twisted into a continuous thread.

spinning just as the long wools are combed and spun by the Bradford or English system.

Carpet and knitting wools are the cheapest, coarsest, and harshest sorts of wools. They come principally from Russia, Turkey, China, Greece, Peru, Chile, etc., and from the mountain districts of England and Scotland. Carpet wools approach more nearly to hair than other wools. The only staple of this class produced in the United States is grown on the original Mexican sheep of the great Southwest. Few of these Mexican sheep are left, for they have been improved by cross breeding, but they constitute the foundation stock of most of our Western flocks, which now produce superior clothing and combing wool.

Sheep Shearing. In order to get an idea of the importance of the sheep industry in the United States, one must take a glance at its condition in the big states of the West. Wyoming has more than 4,600,000 sheep within its borders. Montana, which held the record until 1909, has 4,500,000 sheep. Then comes Idaho with 2,500,000, Oregon with 2,000,000, and so on down the list until the nation's total reaches 40,000,000 sheep, four-fifths of which are west of the Missouri River.

To harvest the wool from such an enormous number of backs is a task that calls for expert shearers, men who can handle the big shears of the machine clippers with a skill that comes from long practice. The shearing must be done at the right time of the year. If the wool is clipped too early, the sheep suffer from the cold; if the shearing comes too late, the sheep suffer from intense heat, and in either case are bound to lose weight and value.

To meet the exacting conditions a class of men has arisen expert in the sheep-shearing business. These shearers begin work in southern and middle California, Utah, etc. Another month finds them busy in the great sheep states of Wyoming, Montana, Idaho,

and Oregon, where they find steady employment until July, when they go to the ranges of Canada. In this way the shearers keep busy nearly all the year, and at high wages.

The Mexicans are particularly expert with the hand shears, though this form of clipping is being done away with, owing to

SHEEP SHEARING

the installation of power plants for machine shearing. These plants are installed at various points on the great sheep ranges. Long sheds are erected and shafting extends down both sides of the shearing place. Twenty or more shearers will be lined up in one of these sheds, each man operating a clipping machine connected with the shafting. The sheep are brought in from the range

in bands of 2500 or more, and are put in the corrals adjoining the shearing sheds. Then they are driven down chutes to the shearers.

A shearer reaches into a small corral behind him and pulls out a sheep. With a dextrous fling the animal is put in a sitting posture between the shearer's knees, and then the steel clippers begin clipping off the wool. The machine-shearing saves much wool, as it gets closer to the skin of the sheep and shears more evenly. In fact, some sheep owners say that the increased weight of their fleeces at each shearing is enough to pay the extra expense of running a power plant.

As fast as the sheep are turned out by the shearers they are run along a narrow chute and each one is branded. The branding mark is usually a letter painted on the back of the sheep so that it can be plainly seen when they are coming through a chute. The mark remains on the fleece and is always easily distinguished.

The shearing season on the plains is much like the threshing season in agricultural communities. With a crew of first-class shearers working in a shearing shed, it is not long until the floor is a sea of wool. Boys are kept busy picking up the fleeces, tying them into compact bundles, and throwing them to the men who have been assigned to the task of filling the wool sacks. These sacks, which hold about 400 pounds, are suspended from a wooden framework, and as fast as the fleeces are thrown in, they are tramped down until the sacks will not hold a pound more. Most of the sacks are shipped to warehouses in such wool centers as Casper, Wyoming, or Billings, Montana, the latter place being the greatest wool shipping center in the world. Here they are sold to Eastern buyers, who examine the clips at their leisure and make their bids.

Fleece. There is a great variation in the weight of fleeces. Some sheep, such as those on the best ranges in Oregon, Montana, and Wyoming, will average an eight-pound fleece full of natural oil, while sheep from the more sterile alkaline ranges of New Mexico will not average much more than five pounds of wool.

Methods of Selling Wools. Roughly speaking, there are seven ways in which the wool grower may dispose of his fleece wool:

1. He may sell it to buyers representing merchants. The merchant, while he is a middle man and therefore incurs the usual anathema, performs a variety of very essential services. At the time of the clip he sends his buyers to the wool producing centers and buys the clip for cash, then he ships it to his warehouse, grades it, and sells to the mills on credit. Obviously he finances a very important part of the production, and is furthermore essential, because he knows the demand, which the woolgrower does not, and the supply — of which the mill is usually ignorant.

2. The wool grower may also sell to buyers representing mills. He likes to do this because he eliminates the merchant's profit, but, as a matter of fact, there are very few mills large enough to stand the buying expense, and even fewer that can afford to buy their whole season's supply of raw material at one time and for cash. Also, mills can usually employ only certain grades.

3. If the grower thinks that he is not receiving fair offers from the visiting buyers, he will frequently consign his wool to a merchant to be sold on commission for his account. In this case he may or may not get a better price, but it costs him his carrying charges plus the commission. There are some wool houses that make a specialty of executing commission sales of this nature.

4. Some wool is sold direct to nearby mills. This is done particularly in Ohio, where many of the smaller mills obtain their entire requirements in this manner.

5. Wool growers sometimes sell to local dealers. This is particularly prevalent in regions where the individual grower's production is small. In most eastern states there are a great number of small farmers who grow a certain amount of wool. The local dealers are in many cases also the general storekeepers, and, since they are the farmer's creditor on other merchandise, and since the average farmer knows very little about the grades

of wool, these dealers very frequently turn a handsome profit when they sell to the visiting buyers.

6. Some wool is sold through farmers' coöperative sales agencies. But these organizations have in the past been so poorly administered, that, as a general rule, they have not been successful.

7. Finally, there remains the method whereby almost all the British and colonial wools are sold, namely, by auction. Auction sales have been established for almost a century in London, Liverpool, Antwerp, Bremen, Hamburg, Marseilles, and recently in Australia. This method of disposing of their raw product does not, however, appeal to the American growers, because of the inherent American trading instinct. It is also not very feasible in this country, because the wool is not graded in the shearing sheds and because sheep-raising is not standardized.

The chief markets for wool in this country are Boston, Philadelphia, Chicago, New York, and St. Louis.

Wool Merchant. On account of the careless method of growing and packing in the United States, no one cares to purchase wool at auction in this country, as is done in other parts of the world. The result is a "middleman," called wool merchant, who buys the wool and attempts to classify it and then sells direct to the mill. It is true that some of the large woolen mills, such as the American Woolen Company, have a large staff of wool buyers who buy direct. Boston is the wool center of the United States and the second largest wool market of the world. Nearly two thirds of both domestic and imported wools used in this country are hurdled through Boston markets.

Value of Wool Business. Some idea of the fortunes at stake in the wool business can be gathered from the following facts:

There are 800,000 farmers raising sheep in this country, some of them in every state. At the beginning of 1923 there were 36,000,000 sheep in the United States, valued at $4.80 a head, or in the aggregate at $172,800,000. It is expected that the returns from the wool clip in a fairly good year will pay all a sheepman's running expenses, such as hire of herders, cost of shearing, etc. He then has the sale of his lambs as clear profit. Enormous fortunes are being made in the sheep business in the West, owing to the high price of wool and mutton. In the last four years the number of sheep has declined 25 per cent, and their value has declined 70 per cent.

The decrease in the production of wool in this country in the last 30 years has been 20 per cent, while the population of the nation has greatly increased. This decrease was due probably to more western land being used for tilling and to a greater consumption of mutton and lamb as food — about 1,000,000 sheep and lambs being slaughtered monthly.

The American production of wool is about 275,000,000 pounds annually, and the consumption is more than double that amount. With mills running under normal conditions, it would be necessary to import annually from 300,000,000 to 400,000,000 pounds.

Foreign Wools. Since the United States does not raise enough wool for our needs, it is necessary to import wool from different countries. Australia is the most important source of the wool supply of the world. That country has more than 100,000,000 sheep. The climate is adapted for sheep raising because the winters are neither long nor cold and large areas are unsuitable for agriculture. The sheep are raised primarily for wool and not for mutton.

Most of the foreign wools are sold at auction in one of the wool centers of England, such as London, Bradford, etc.

The following are the principal foreign wools:

Saxony and Silesian Wools. Among wools of all classes the Saxony and Silesian take the first place, and for general good qualities, fineness, and regularity of fiber, they are unequalled. The fiber is short in staple, possesses good felting properties, and is strong and elastic. This wool is used chiefly in the manufacture of cloths where much milling [1] is required, such as superfines and dress-faced fabrics.

Australian Wools. Australia furnishes wools of a superior character, and some of the choicest clips rival the Saxony and Silesian wools. They are used both for worsted [2] and woolen yarns. They are generally strong and elastic, possess numerous serrations, and are of good color, with good felting properties. The principal Australian wools are Port Philip, Sydney, and Adelaide. These are the best brands imported from that country.

Port Philip Wool. Port Philip wool is suitable for either worsted or woolen yarns. The fiber is not quite as fine as Saxony, but it makes a good thread, is fairly sound in staple, and is of good length and color. It is very wavy and serrated. The longest and best of this wool is used for the very finest worsted yarns, and will spin up to 130's counts.[3] The sheep are descendants of the original Spanish Merino. Cross-bred Port Philip wool is from the same Merino sheep crossed with Leicesters, which yield a medium quality fleece of sound fiber and good quality for spinning counts from 40's to 56's. The yarn has a bright, clear appearance.

Sydney Wools. Sydney wools are moderately fine in fiber and of medium length. They are rather deficient in strength, uneven in color, and often contain yellow locks which make them undesirable when required for dyeing light shades. They are used for nearly the same purpose as Port Philip wools, but do not spin quite so far in worsted yarns, nor are they equal in milling qualities.

[1] A process of finishing cloth by condensing the fibers so as to make the cloth stronger and firmer.

[2] See footnote, page 46.

[3] The size of yarn is technically called the "counts" and is based on the number of 560 yard lengths required to weigh one pound. In this case 130's count = 130×560, or 72,800 yards of yarn to a pound.

Adelaide Wool. Adelaide wool has a reputation for sound Merinos, the average quality being a little lower than for the Port Philip and Sydney wools. Its fiber is moderately fine, but not of uniform length; its color is not so good, and it contains a large amount of yolk.[1] Adelaide wool is used for worsted dress goods, weft (filling) [2] yarn up to 60's, and certain worsted warps.[2] It is used for medium fancy woolens.

Van Wool from Tasmania. The climate of this island is well

MERINO SHEEP

suited to the growing of wool, and produces excellent qualities, fine in fiber, of good length, and strong in the staple, which will spin as high counts as 70's and 80's worsted. This wool is useful for mixing with other good wools. Its color is very white, which makes it a useful wool for dyeing light shades. Its milling properties are good, and the shorter sorts are suitable for woolens.

New Zealand Wools are very supple, which make them valuable to the spinner. These wools are suitable for almost all classes of Merino and cross-bred yarns. They are of good length, sound

[1] An encrusting compound of dirt and grease formed on the fleece.

[2] See page 34.

staple, have good felting properties, and are of good color. They are useful for blending with mungo and shoddy, to give to these remanufactured materials that springy, bulky character which they lack.

Cape Wools. Cape Colony and Natal produce Merino wool that is somewhat short in staple, rather tender, and less wavy than some other wools. The sheep are not so well cared for, and are fed on the leaves of a small shrub. The absence of grass leaves the ground very sandy, and this makes the fleece heavy and dirty. Its color is fair, but it lacks elasticity. It is used chiefly to cheapen blends [1] of 60's top.[2] The short wool is combed for thick counts for weft and hosiery, and is also used for shawls and cloths where felting is not an essential feature.

Wools from South America. These wools are of the same standard of excellence as the Australian wools, but they are generally deficient in strength and elasticity. Buenos Ayres and Montevideo wools are fairly fine in fiber, but lack strength and elasticity, and are deficient in milling properties; they are also burry. The climate suits the sheep well, and the feed is good, but the careless methods of classing and packing have earned for these wools a poor reputation that is well deserved.

The best 60's wool is combed in oil, but a large portion of the shorter is combed and used in thick counts — 20's to 36's worsted for the hosiery trade.

Russian Wool. The staple of this is generally strong, and the fibers are of a medium thickness; the color is milky white. It is useful to blend with Australian or other good wools. It produces a good yarn, and is very often used in the fancy woolen trade and in fabrics that are to be finished in the natural color.

Great Britain Wools. These may be divided into three groups: (1) long wools, of which the Lincoln and Leicester are typical examples; (2) short wools, which include Southdown, Shropshire, Suffolk, and others; and (3) wool from the mountain or hilly breeds of sheep, such as the Cheviot, Scotch Blackface, Shetland, Irish, and Welsh.

Lincoln Wool is a typical wool obtained from the long-wool sheep, and noted for its long, lustrous fiber, which is silky and

[1] Mixtures. [2] After wool fibers are combed they are called top.

strong. The staple varies from ten to eighteen inches in length, and the average fleece will yield from ten to fourteen pounds in weight.

Leicester Wool has a somewhat finer fiber than Lincoln. It is a valuable wool, of good color, uniform and sound in staple, curly, with good, bright luster and no dark hairs. While luster wools are grown extensively in England, they also grow in Indiana and Kentucky, and are commonly known in the trade as braid wools.

Southdown is one of the most valuable of short staple wools.

WOOL MARKET AT BUENOS AYRES

It possesses a fine hair, is close and wavy, and fairly sound in staple, but rather deficient in milling qualities. The shorter varieties are carded and made into flannels and other light fabrics, while the longer qualities are used in the production of worsted goods. The weight of a Southdown fleece averages from four to five pounds.

Shropshiredown Wool is of good quality, with strong, fine, lustrous fiber, of good length. It resembles Southdown, but is not as lustrous as mohair, the natural colors being either white, black, brown, or fawn. It is used chiefly in the manufacture of dress goods.

The Norfolkdown and Suffolkdown Wools are fairly fine in fiber, and soft, but slightly deficient in strength and elasticity.

Cheviot Wool may be taken as representative of that of the hill breeds of sheep. It is an average wool, with staple of medium length, soft, and with strong and regular fiber; it is of a good, bright color, and possesses desirable milling properties, being used for both woolen and worsted, but chiefly in the fancy woolen trade. The average weight of the fleece is about $4\frac{1}{2}$ pounds. The blackfaced or Highland breed yields a medium wool, coarser and more shaggy than the Cheviot, and varying much in quality. It is almost all used in the production of rugs, carpets, and blankets.

Welsh Wools lack waviness and fineness of fiber. They are used chiefly for flannels.

Shetland Wools are similar in character to Welsh wools, but slightly finer in fiber, and softer. They are used in the manufacture of knitted goods, such as shawls and wraps. They lack felting properties.

Irish Wools possess a strong, thick hair of moderate length and fine color. They are similar in many respects to the Welsh wools, and are often classed with them. They are used in the production of low and medium tweeds — fancy woolen cloths not requiring small yarns or milling qualities.

When we speak of wool we generally mean the hair of sheep, but as a matter of fact there are other animals, like *alpaca*, *angora*, *vicuna*, *goats*, *camels*, etc., which furnish a form of wool. Scientifically speaking all animals are covered with some form of hair. The softest hair or wool is obtained from the Merino sheep, and the coarsest hair — bristles — from the boar's back. Between these two limits there are hairs of all shades of fineness. The principal ones that are used for clothing are mohair, cashmere, alpaca, vicuna, and camels' hair.

Mohair is a lustrous wool obtained from the Angora goat, which derives its name from the district of Asia Minor from which it comes. These animals have also

been successfully bred in Spain and France and the United States. The hair is pure white, fine, wavy, and of good length, and possesses a high luster. It is used in making plushes, velvets, astrakhans, and curled fabrics, also half-silk goods and fine wraps, because it has a *high silky luster* and no *curl*. It does not take the dyestuff easily, and when it is dyed it is inclined to be harsh in feel.

Alpaca Wool is a fleece of the Peruvian sheep, which is a species of the llama. The staple is of good length and soft, but is not quite as lustrous as mohair, the natural colors being either white, black, brown, or fawn. It is used chiefly in the manufacture of dress goods. The fibers usually are six or eight inches long, slightly wavy, and are rather fine in feel. The natural colors are white, brown, black, and red.

Vicuna Wool is obtained from the wild goat. Very little of this wool is obtained, owing to the scarcity of the animal. It has a fine, silky luster, reddish brown color, and possesses considerable felting property. A *vicuna fabric* to-day refers to a slightly napped fabric of soft wool mixed with cotton in imitation of the genuine article. *Vicuna yarn* refers to a soft mixture yarn of wool and cotton or all cotton yarn finished in imitation of woolen yarn.

Cashmere Wool is the fine, woolly, extremely soft, white and gray fur of the Cashmere goat which is bred in Thibet, Asia. There are two kinds of fibers obtained: one, which is really the outer covering, consists of long tufts of hair; underneath this is the

Cashmere wool of commerce, a soft, downy wool of a brownish-gray tint, with a fine, silky fiber. It is used for making the costly oriental (Indian) shawls and the finest wraps requiring soft naps, because it has spinning and felting qualities similar to Merino wool.

Cow and Horse Hair. Various other fibers, such as cow and horse hair, are used. *Cow hair* is used for coarse fabrics, such as blankets, carpets, etc. *Horse hair* is used for upholstery fabrics, *stiffening*, and underlining for coats. Since it lacks the scaly surface it cannot be spun.

Camels' Wool. Camels' wool is the soft, downy hair next to the body of the camel. Since the desert has warm days and cool nights, the camels' wool must be very *warm* and also *light* in weight, as the camel is obliged to travel long distances. The wool is very fine, curly, of great strength, with a natural color of brown, yellow, or red. It makes a fine, soft, dressy fabric, with a glossy, slightly hairy finish. Very few genuine camels' wool fabrics are on the market, but there are a number of imitations made from sheep's wool for dress goods, blankets, felt hats, etc.

QUESTIONS

1. What is wool? How long has it been used?
2. Name the chief physical qualities of wool.
3. Draw a sketch of a wool fiber.
4. What is the chemical composition of wool?
5. Why are tensile strength and elasticity important qualities in wool fiber that is to be used for clothing?
6. Describe the difference between wool and hair.

7. (*a*) What is meant by the term "Merino wool"?
(*b*) Describe the process of developing Merino wool.
8. (*a*) What are the two uses of sheep?
(*b*) Describe the physical appearance of each breed.
9. What are the objections to raising sheep on the New England hills?
10. How are wools named?
11. What is meant by: Cross-bred wool, territory wool, fleece wool, domestic wool?
12. (*a*) Describe the old method of classifying wool.
(*b*) Explain the qualities of carding, clothing, and carpet wools.
13. How is the fineness of wool expressed?
14. What have the fineness and other qualities of wool to do with the clothing that we wear?
15. Define the expressions: (*a*) three-quarters blood; (*b*) three-eighths Merino wool.
16. (*a*) Describe the operation of shearing sheep.
(*b*) Why is this process very important to the wool?
17. (*a*) What is meant by a fleece of wool?
(*b*) How many pounds does it weigh?
(*c*) Is the fleece pure wool?
(*d*) What objections are there to the washing of wool on the sheep's back thereby saving the expense of transportation?
(*e*) Where are the large wool markets in the U. S. to be found?
18. (*a*) Name the different methods of selling wool.
(*b*) State the advantages of each method.
19. Describe the importance of the wool merchant.
20. Give figures showing: (*a*) Amount of capital in the wool industry; (*b*) number of people engaged; (*c*) number of sheep involved; (*d*) number of sheep in U. S.
21. Why is it necessary to import wool into this country?
22. (*a*) Name some of the chief foreign wools.
(*b*) State some of the characteristics of each of the foreign wools.
23. State properties of: Cashmere, cow hair, camels' hair.

CHAPTER III

WOOL SORTING

How Wool is Marketed. The bulk of the wool of commerce comes into the market in the form of *fleece* wool, the product of a single year's growth, and cut from the body of the animal usually in April or May. The first and finest clip, called *lamb's* wool, may be taken from the young sheep at the age of eight to twelve months. All subsequently cut fleeces are known as *wether* wool and possess relatively somewhat less value than the first clip. Various species of sheep furnish widely different qualities of wool, so it is necessary to grade fleeces according to fineness.

Grades of Wool. In the grading of wool no set standard of quality exists. The same classification may be applied in different years, or in different localities, to qualities of wool showing much variation, the best grade obtainable usually setting the standard for the lower grades. The highest quality of wool in the United States is found on full-blooded Merino sheep.

Fleece wools are graded by two systems, one by bloods, the other by counts spun (this means the number of hanks of 560 yards each to a pound of yarn). Domestic and foreign wools are usually graded by bloods. U. S. territory wools are graded a little differently, (second column below), and pulled wool

is only roughly graded into four classes (third column). The blood classifications originated from the breeding of the sheep, but, as a matter of fact, they have become arbitrary terms denoting a certain degree of fineness. The same fleece may, and frequently does, contain ½, ⅜, and ¼ blood wool.

Comparative Grades

U. S. Domestic	U. S. Territory	Pulled	U. S. Counts Spun	Foreign Counts
Full blood (XX)	Fine	AA	60s	66–74s
¾ "	¾		50s	60–66s
½ "	½	A	40s	54–60s
⅜ "	⅜	B	36s	48–54s
¼ "	¼	B	32s	44–48s
Low ¼	Low ¼	C	20s	40–44s
Common	Common	C	16s	36–40s
Braid	Braid	C	12s	32–36s

When a bag of domestic wool is opened the fleeces are taken out one by one and put into baskets according to the grades in the first column. The grader simply decides what the majority of the fleece is and puts it into that class. When he has filled a basket with, let us say, half-blood fleeces, this basket is given to a sorter. He takes each fleece, shakes it out, and, first of all, skirts it. Then he separates it into the various sorts it contains. Fleeces graded as half-blood will probably sort into mostly half, some fine (full-blood), and a considerable quantity of three-eighths blood. The best wool comes off the shoulders, then the sides, then the back, then the thighs, and finally the britch and belly. Usually a fleece does not contain more than three sorts.

If this were a bag of Australian, South American, or Cape wool, the fleeces would in all probability have been bagged according to grades, so that only the sorting operation would have to be performed by the merchant or the mill.

When the wool has been sorted it is put into bins, and may now be said to be ready for the first of the manufacturing processes for which it is destined. Sorting is sometimes done by the merchants, but more frequently by the manufacturers.

Kempy (hairy) or cotted pieces, tags, stained or painty wool, etc., are called off-sorts, and these are put through a number of

processes for the purpose of reclaiming as much of the wool as possible.

The qualities usually looked for in wool are six, and they vary according to the purpose for which wool is to be used.

1. It must be fine enough to spin the required number of counts.
2. It must be strong enough to withstand the strain of manufacture.
3. It must have the proper staple (length).
4. It must be of a certain softness or hardness.
5. It must have the proper felting qualities if the material is to be fulled.
6. It must either scour white, or else have sufficient luster to take dyes.

As we take up the manufacture of worsted and woolen yarns we shall see how these qualifications play a different part in the two processes. For the present the only difference we are concerned with is staple length. Generally speaking, wools under two inches are too short to be combed and are classed as clothing wools. Clothing wools are used for woolens, and combing wools for worsteds.[1]

In grading and sorting, practically the only guide is the fineness of the individual fiber. The other qualifications just enumerated have a very important bearing on what the wool can be used for, but they have very little to do with its classification by grades.

Difference Between Lamb's and Sheep's Wool. One of the first points to be understood in wool sorting is the difference between the wool of lambs and one-year-old sheep, and that of sheep two or more years old. Lamb's wool is naturally pointed at the end, because it has never been clipped. It is termed *hog* or *hoggett* wool, and is more valuable when longer, of about fourteen months' growth. It is finer in quality and possesses more waviness, which is a help in the process of spinning.

The wool of sheep two or more years old is known as *wether*.

[1] In recent years combing machinery has been devised which will comb wools under one inch in length, so that a considerable quantity of "clothing wools" now go into worsteds.

The ends of the fiber from such sheep are thick and blunted, on account of having been previously cut. It is necessary to be able to tell at once a hog fleece from a wether, and this can be done in two ways: by examining the ends of the fiber to see if they are pointed; or by pulling a staple out of the fleece. If it is wether, the staple will come out clean, without interfering to any extent with those around it; but if hog, some of the fibers will adhere to the one that is being pulled. Hog wool is generally more full of dirt, moss, straw, and other vegetable matter.

Dead Wool is wool obtained from the pelts of sheep that have died.

Delaine Wool is a variety of fine, long, combing wool.

Cotty Wool, or cotts, is wool from sheep that have been exposed to severe weather and lack of nourishment, and for these reasons have failed to throw off the yolk necessary to feed the wool. As a result it becomes matted or felted together, and is hard and brittle and almost worthless.

Pulled Wool. We have discussed above the shearing and marketing of wool obtained from the living animal. There remains a large quantity of wool which is taken from the pelts of slaughtered sheep and called *pulled wool.* In 1919 there were produced in the U. S. 48,300,000 pounds of pulled wool and about 265,939,000 pounds of sheared wool. Skin wool, or tanner's wool, as it is sometimes known, is used extensively for soft twist yarns, bed blankets, flannels, felts, etc. It is also used as an admixture in blends for top-making, as we shall see later. There are three methods whereby pulled wool is obtained. The oldest and simplest process is known as "sweating," and consists simply in sweating the hides until the wool is loosened and can easily be pulled out. The disadvantage of this method is that it injures the hides. The lime process loosens the wool by painting the flesh side of the hide with lime. This also injures the hides somewhat and has a bad effect on the dyeing qualities of the wool.

The depilatory process is the best, and varies from the lime process only in that a solution is used instead of lime. This mixture consists of sodium sulphate, sulphuric acid, and oyster shells.

Parts of Fleece. Fleece wool as it comes to the mill is rolled up in bundles and must be sorted. This process consists in sorting and classifying the fibers of the fleece. Not only do the various species of sheep furnish widely different qualities of wool, but different qualities are obtained from the same animal, according to the part of the body from which the wool is taken. This variation in some instances is very marked, and sometimes is greater than that which separates the wools of the different breeds of sheep. Hence the sorting and classing of wool become necessary for the production of good, sound yarn of even quality.

An attempt to utilize the fleece as a whole would result in the spinning of uneven, faulty, and unsatisfactory yarns or threads. As many as twelve or fourteen sorts may be obtained from one fleece (by very fine sorting), but generally not more than five or seven are made. The following list shows the relative qualities of wools from the various parts of a Merino sheep:

1 and 2. *Head (top and sides)*: The wools grown on these parts are remarkable for length of staple, softness, and uniformity of character. They are usually the choicest wools in the fleece.

3. *Upper part of the back:* This also is a wool of good, sound quality, resembling in staple Nos. 1 and 2, but not as soft or as fine of fiber.

4. *Loin and back:* The staple here is comparatively short, not as fine, but generally of unvarying character, sometimes rather tender.

5. *Upper parts of legs:* This wool is medium in length but coarse of fiber, and has a tendency to hang in loose, open locks. It is generally sound, but likely to contain vegetable matter.

6. *Upper portion of the neck:* The staple clipped from this part of the neck is of an inferior quality, frequently faulty and irregular in growth, and often contains twigs, thorns, etc.

7. *Central part of the neck:* This wool is similar to No. 6 but is rather tender in staple.

8. *Belly:* This wool is from under the sheep, between the fore and hind legs. It is short and dirty, poor in quality, and generally tender.

9. *Root of tail:* The fibers are coarse, short, and glossy.

10. *Lower parts of the legs:* This wool is generally dirty and

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greasy, the staple having no wave and lacking fineness. It is generally burry and contains much vegetable matter.

11. *Front of Head;* 12. *Throat;* 13. *Chest:* The wools from these parts are sometimes classed together. The fiber is stiff, straight, coarse, and covered with fodder.

14. *Shins:* This is another short, thick, straight wool of glossy fiber, commonly known as shanks.

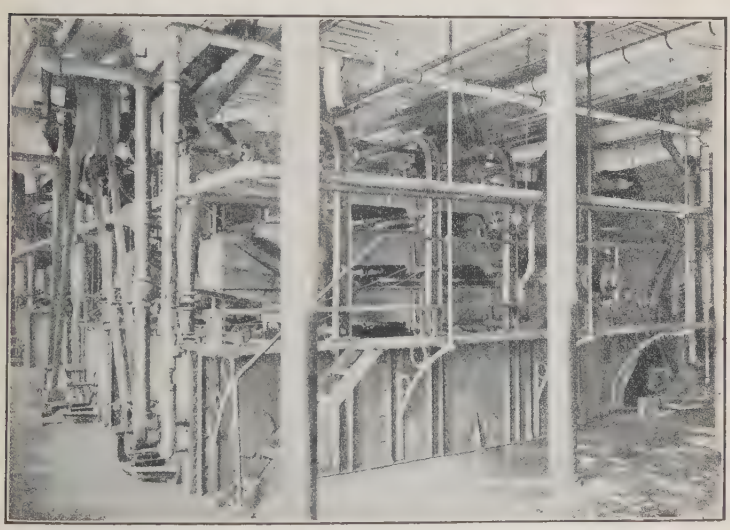
Classing. Classing is a grading of the fleeces, and is usually, but not always, a process preliminary to sorting. It is an important part of sorting, and when well done greatly facilitates the making of good, uniform matchings.

Wool Sorter. The sorter begins by placing the fleece upon his board or table, always arranging it so that he faces the north, as this gives the most constant light and no glare of the sun. The fleece thus spread out shows a definite dividing line through the center. The sorter parts the two halves and proceeds to analyze their different qualities. The number of sorts is deter-

SORTED WOOL IN PILES READY TO BE TRANSPORTED TO THE DEGREASING PLANT

mined by the requirements of the manufacturer who, in purchasing his wool, buys those grades that will produce the greatest bulk of the qualities for present use, and that leave in stock the smallest number of sorts and least weight for which he has no immediate use. The sorter then removes all extraneous matter adhering to the fleece, such as straw, twigs, and seeds, and cuts off the hard lumps of earth, tar, or paint. With these preliminaries finished, he proceeds to cast out the locks, according to quality, into baskets or skeps provided for that purpose. After skirting or taking off the outside edges of the fleece, usually known as brokes, and the legs and tail, known as breech, he separates the other portions from the better qualities.

It may be noted that the quality of the wool varies in the same way as the quality of the flesh. The shoulder is finest in grain and most delicate, so the wool is finer in fiber. There is more wear and tear for the sheep at its haunches than at its shoulders, hence the wool is longer and stronger; about the neck the wool is short, to prevent the sheep from being weighted down while eating, etc.; the wool on the back becomes rough and thin, being



WASHING ROOM

most exposed to the rain. From the foregoing it will be readily seen that there is necessity for careful sorting, in order to insure an even running yarn, and a uniform quality of fabric.

Wool Washing. Fleece wool as it comes into the market is either in the "grease," that is, unwashed and with all the dirt which gathers on the surface of the greasy wool; or it is received as washed wool, the washing being done as a preliminary step to the sheep shearing. Wool, unlike cotton, cannot be worked into yarn without being thoroughly cleansed of its impurities. These impurities consist of greasy and sweaty secretions, of the nature

of a lubricant to the fiber. Combined with dirt, sand, etc., which adhere to the wool, these secretions form an encrusting compound, known as yolk, which acts as a natural preservative to the wool, keeping it soft and supple. This compound, with other extraneous matter, must be removed before the wool is in a workable condition. The amount of yolk varies, the greatest amount being found in fine, short wools from the warm climates. In long-staple wool the amount of yolk is comparatively small.

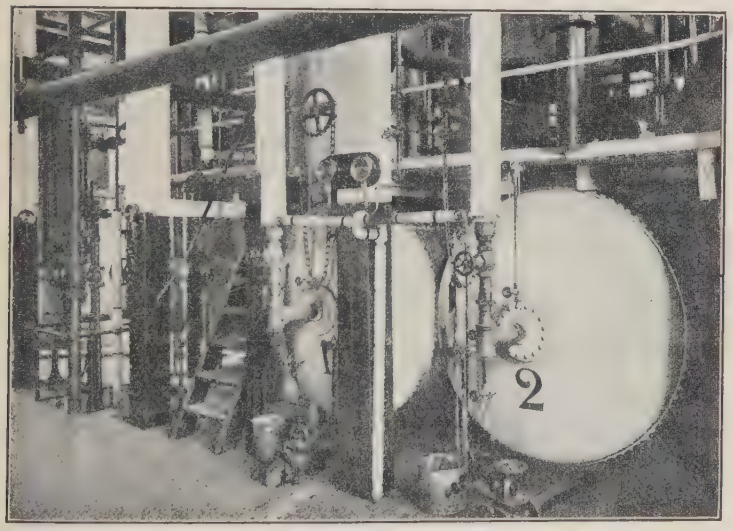
Various methods of removing these impurities have been tried; one is the use of absorbent substances, such as fossil meal, alumina, etc., to withdraw the greasy matter, so that the remaining impurities can be easily removed by washing. In other methods, naphtha or similar solvent liquids are used to dissolve the wool fats. This is followed by washing in tepid water to dissolve the potash salts, leaving the dirt to fall away when the other substances are no longer present. To use this method with safety requires a costly and intricate plant with skilled supervision. The method in almost universal use is washing the wool in alkaline solutions, properties of which combine with and reduce the impurities to a lathery emulsion which is easily washed off from the wool.

Great stress is laid upon the necessity of care in the washing process, as the luster may be destroyed and a brownish-yellow tint given to the wool, the spinning properties very seriously injured, the softness destroyed, or the fiber dissolved. Some wools are easy to wash, requiring little soap and a moderate temperature; other wools are cleansed with great difficulty. A note, therefore, should be made of any particular brand or class of wool requiring special attention, to serve as a guide in the treatment of future lots. The danger lies in using unsuitable agents, — hard water, excessive temperatures, strong reagents, etc.

Caustic alkalies have a most destructive effect on wool as they eat into it and destroy its vitality. Carbonate alkalies are less severe. Whatever cleansing substances are used, it is essential that they should be free from anything that is likely to injure the wool — that they remove the impurities and still preserve all the qualities in the wool. If the washing is properly performed the alkaline portion of the yolk is removed, leaving only the colorless animal oil in the fiber. If the work is not thoroughly done the

wool passes as "unmerchantable washed." "Tub washed" is the term applied to fleeces which are broken up and washed more or less by hand. Scoured wool is tub washed with warm water and soap, and then thoroughly rinsed in cold water until nothing remains but the clean fiber.

An improved method of washing wool by hand is to have a series of tanks with pressing rollers attached to each tank; the



DEGREASING PLANT — REMOVING GREASE FROM WOOL

wool is agitated by means of forks and then passed to the pressing rollers and into each tank in succession. The tanks are usually five in number and so arranged that the liquor can be run from the upper to the lower tank. Upon leaving the pressing rollers the excess of water is driven off in a hydro extractor [1] and the wool is beaten into a light, fluffy condition by a wooden fan or beater.

[1] A wire cage enclosed in a metallic shell which revolves at a high speed, causing sixty or seventy per cent of the moisture to be removed.

Wool Drying. The process of drying wool is not intended to be carried to such an extent that the wool will be in an absolutely dry state, for in such a condition it would be lusterless, brittle, and discolored. It is the nature of wool to retain a certain amount of moisture since it is hygroscopic, and to remove it entirely would result in partial disintegration of the fibers. Buyers and sellers have a recognized standard of moisture, — 16 per cent. If, on the other hand, it is left too wet, the fibers will not stand the pulling strain in the succeeding operations, and if not broken, they are so unduly stretched that they have lost their elasticity.

Burring and Carbonizing. After wool has been washed and scoured it frequently happens that it cannot be advanced to the succeeding operations of manufacture because it is mixed with burs, seeds, leaves, slivers, etc., which are picked up by the sheep in the pasture. These vegetable impurities injure the spinning qualities of the stock, for if a bur or other foreign substance becomes fastened in the strand of yarn while it is being spun, it either causes the thread to break or renders it bunchy and uneven. For removing burs, etc., from the wool two methods are pursued: the one purely mechanical, the other chemical, and known respectively as burring and carbonizing.

Bur Picker. For the mechanical removing of burs a machine called the bur picker is employed. In this machine the wool is first spread out into a thin lap or sheet; then light wooden blades, rotating rapidly, beat upon every part of the sheet and break the burs into pieces. The pieces fall down into the dust box or upon a grating beneath the machine, and are ejected together with a good deal of the wool adhering to them. Often the machine fails to beat out fine pieces and these are scattered through the stock.

Process of Carbonizing. For the complete removal of all foreign vegetable substances from wool the most effective process is carbonizing, in which the burs, etc., are burned out by means of acid and a high degree of heat. The method of procedure is as follows: The wool to be treated is immersed in a solution of sulphuric or hydrochloric acid for about twelve hours, the acid bath being placed in cement cisterns or in large lead-lined tubs and not made strong enough to injure the fiber of the wool. During the immersion the stock is frequently stirred. Next, the wool is dried and then placed in an enclosed chamber and subjected to a high temperature (75 degrees C.). The result of this process is that all the vegetable matter contained in the wool is carbonized or burned to a crisp, and on being slightly beaten or shaken readily turns to dust. This dust is removed from the wool by various simple processes. The carbonizing process was first introduced in 1875, though it made but slight headway against the old burring method until after 1880.

QUESTIONS

1. Define the following terms: Clip, fleece, lamb's wool, wether wool.
2. Is it possible to use the whole fleece in the making of cloth? If not, give the reason.
3. Describe methods of grading wool.
4. Define the following terms: Dead wool; pulled wool; delaine wool; cotty wool.
5. Explain the difference between lamb's and sheep's wool.
6. (*a*) Describe the process of wool sorting.

   (*b*) Explain why it is impossible to use all the wool in a fleece for the same purpose.
7. On what part of the sheep is the (*a*) best and (*b*) poorest wool found?
8. Describe the condition of the wool as it comes from the sheep's back.
9. How is wool in " the grease " cleaned?
10. What is meant by carbonizing wool?
11. Describe how scoured wool is obtained.

CHAPTER IV

REMANUFACTURED WOOL — SHODDY

Need of Shoddy. There is not sufficient new wool, called virgin wool, raised every year to supply the world's needs for clothing. Figures recently compiled show that there is less wool raised to-day than a few years ago. Therefore, in order to meet the demands for clothing made of wool, various attempts are made to use over again wool from old clothing and waste. For example, old rags are sold by the housewife to a rag dealer for a few cents a pound. The rag dealer will take the rags to his loft and sort them into hard surface rags, like men's trouserings (mungo), soft surface rags, as women's skirting, unions (mixture of cotton and wool), etc. These assortments are then subdivided into at least seventy-five mixtures and sent to the shoddy mill to be ground (torn) into fibers and mixed with virgin wool for new yarn for woolens.

Remanufactured wool substitutes are extensively used in the manufacture of woolen goods. There is no need for the prejudice that is sometimes met regarding these reclaimed materials, for by their use millions of people are warmly and cheaply clothed. If the immense quantity of these materials were wasted, countless persons would be unable to afford proper clothing, as

it is difficult to estimate what the price of wool would be. In almost all instances the use of wool substitutes is for the special purpose of producing cloths at a much lower price. The operations used in making cloth from remanufactured wool remove all dust, germs, etc., from the original material.

The cloths made from waste products, such as noils, are not much inferior in quality to those produced from the wool from which the noils are obtained; but the great majority of cloths made from other waste products are much inferior. The following are the most important substitutes: *noils*, *shoddy*, *mungo*, *extract-wool*, and *flocks*.

Noils are the rejected fibers from the process of combing the different wools and hairs; thus, wool noils are from the sheep, mohair noils from the Angora goat, and alpaca noils from the Peruvian sheep.

Noils are divided into classes, namely, long-wool noils, short or fine-wool noils, mohair noils, and alpaca noils. They are all obtained in the process of combing, that is, the process which separates the long from the short fibers; the former are known as the "top," and are used in worsted and in the production of mohair and alpaca yarns; while the latter are used to advantage in the production of many different kinds of woolen fabrics. With the exception of length, noils are practically of the same quality as the tops from which they are taken.

Long-wool noils are obtained from the combings of Leicester and similar wools. These noils, like the wool from which they are obtained, are much coarser in quality and fiber than the short-wool noils. Occasionally, when strength is required in the fabric, these noils are used, and they are also mixed with short-wool noils. Many of the cheviot fabrics are made exclusively of these noils. They are also mixed with shoddy and cotton in the production of dark-colored fabrics, and in medium and low-priced

goods requiring a fibrous appearance they are extremely useful.

Short or fine-wool noils are the most valuable, and are obtained from combing Australian and other fine wools. The number and variety of uses to which they are put are innumerable. They are used to advantage in the plain and fancy woolen trade, in the manufacture of shawls and plain woolens of a soft nature, and are also suitable for mixing with cotton in the production of twist threads.

Mohair and alpaca noils are obtained by the combing of these materials. They are lacking in felting properties, but are lustrous and possess strength, and are most valuable in the manufacture of fabrics where strength and luster are required. These noils are used in the production of yarns for Kidderminster carpets, as yarns for these carpets must possess strength, brightness, and thickness of fiber. They are also used in combination with shoddy and cotton to produce weft or filling yarns for a lower quality of goods.

Shoddy and **Mungo** are in reality wool products, or wool fiber which has previously passed through the processes of manufacture, by which its physical structure has been considerably mutilated. These were first produced about sixty years ago. Shoddy is higher in value than mungo. The value and quality of the waste or rags from which it is made determine the quality or value of the material. Shoddy is derived from waste or rags of woolens, such as flannels, wraps, stockings, and all kinds of soft goods.

Mungo is made from rags of hard character and is much shorter in fiber than shoddy. Its length, varying from one quarter to three quarters of an inch, can be regulated by the treatment the rags receive, and by the proper setting of the rollers in the grinding machine.

Both shoddy and mungo may be divided into classes. Mungo is divided into two classes, namely, new and old mungo. New mungo is made from rags chiefly composed of tailor's clippings, unused pattern-room clippings, etc. Old mungo is made from cast-off garments, etc. By a careful selection of the rags previous to grinding, it is possible to make a large number of qualities, and a great variety of colors and shades without dyeing. Owing to their cheapness shoddy and mungo are used in cloths of low and medium qualities. Shoddies are utilized in fabrics of the cheviot class and in the production of backing yarns. Mungoes of the best quality are used in the low fancy tweed trade, in both warp and weft, but chiefly in union and backed fabrics.

Extract Wool. This is obtained from union cloths, that is, from cloths having a wool weft and warp of cotton, etc., also from cloths having the same material for warp, but possessing a woolen or mungo warp or filling, etc. It is the wool fiber that is required.

Therefore the vegetable matter (cotton) must be extracted from it by the process of carbonizing. To effect this, the tissue or rags are steeped in a solution of sulphuric acid and water and then subjected to heat in an enclosed room. The water is evaporated, leaving the acid in a concentrated form, which acts upon the cotton, converting it into powder. The powder readily becomes separated, and thus the cotton is eliminated. The material that is left is well washed to remove all acid, dried, and then passed through a miniature carder, to impart to it the appearance of a woolly and softer fabric.

Flocks. These are of three kinds, and are waste products of the milling, cropping, and raising operations.

The most valuable are those derived from the fulling mill, being clean and of a bright color. They are chiefly used by sail spinners and in the manufacture of low grade cloths of the cheviot class. White flocks are suitable for blending with wool, and as a rule command a fair price. Raising flocks are those obtained from the dressing or raising gigs, and are applied to purposes similar to those for which fulling flocks are used. Cutting or cropping flocks are the short fibers which are removed from the cloths in this operation. They are practically of no value to the textile manufacturer, being unfit for yarn production, but are used chiefly by wall-paper manufacturers in producing "flock-papers," which are papers with raised figures resembling cloth, made of poor wool, and attached with a gluey varnish.

Method of Producing Shoddy and Mungo. Before the fibrous mungo is obtained, the rags have to pass through the following preliminary operations:

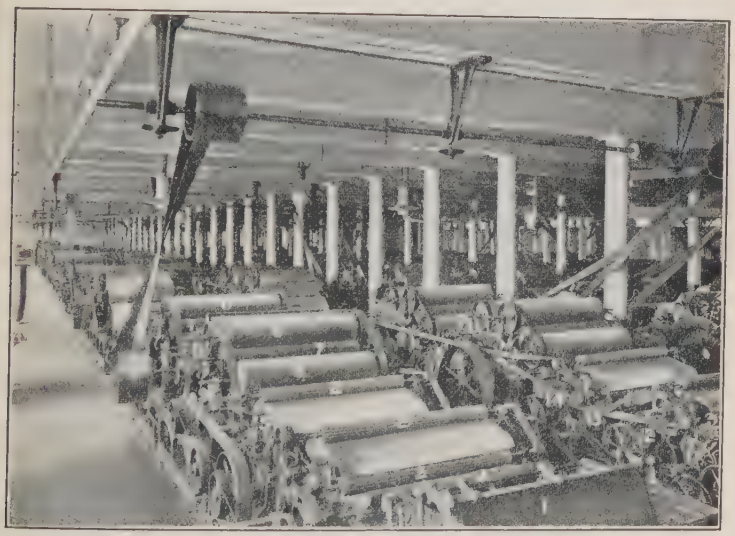
Dusting. This is carried on in a shaking machine, which consists of a cylinder possessing long and strong spikes, which are enclosed, having underneath a grating to allow the dust to pass through. The dust is then driven by a fan into a receptacle provided for that purpose.

Sorting. All rags, both old and new, must be sorted, and considerable care must be exercised in this operation, as on this work alone depends the obtaining of different qualities and shades, as well as the securing of the production of a regular and uniform product.

Seaming. This is only necessary with the rags procured from garments. It is simply removing the cotton threads from the seams and any metallic or hard substances from the rags.

Oiling. The rags are oiled to soften them and make them more pliable and thus to facilitate the grinding.

Grinding. This is the principal operation, and the rags are made fibrous in this process. The machine by which this is effected is made up of the following parts: feed apron, fluted rollers, swift, and a funnel for conveying the material out of the



CARD ROOM

1. Automatic Feed.
2. Bur Guards.
3. Bur Tray.
4. 1st Top Divider.
5. 2d Top Divider.
6. Workers.
7. Strippers.
8. Doffer Cylinder.
9. Main Cylinders.
10. Main Card Drive on 2d. Main Cylinder Shaft.
11. 1st Lickerin.
12. 2d Lickerin.
13. 3d Lickerin.
14. 4th Lickerin.
15. Fancy Hood.

machine. The principal features of the machine are the swift and its speed. The swift is enclosed in a framework, and is about forty-two inches in diameter and eighteen inches wide, thus having a surface area of 2376 square inches, containing from 12,000 to 14,000 fine strong iron spikes. The speed of the swift may be from 600 to 800 revolutions per minute. The rags are fed by placing them on the traveling feed apron, and are thus conveyed to the fluted rollers. As they emerge from the rollers

they are presented to the swift, and by strong iron teeth, moving with exceedingly high surface velocity, they are torn thread from thread and fiber from fiber. The fluted rollers run very slowly, and the rags are held while the swift carries out this operation. By means of the strong current of air created by the high speed of the swift, the mungo is expelled from the machine through the funnel into a specially arranged receptacle. If by any chance the machine should be overcharged, that is, if too many rags are passing through the rollers, the top fluted roller is raised up, and the rags are simply carried, or thrown by the swift, over into a box on the opposite side of the machine without being subjected to the tearing process. The top roller is weighted by levers with weights attached to keep it in position, thus bringing downward pressure to bear upon it, as it is driven simply by friction. By the adjustment of the feed rollers in relation to the swift, the length of the fiber may be varied to a small degree.

QUESTIONS

1. Why is it necessary to use wool over again?
2. Define the following terms: mungo; shoddy; flocks; noils; extract wool; virgin wool.
3. Describe the method of producing shoddy.
4. Is shoddy wool as good as virgin wool?

CHAPTER V

THE MANUFACTURE OF WOOLEN AND WORSTED YARNS

Fundamental Operations. The operations of taking the uncleaned fibers in mass and reducing them down to a *thread* called *yarn* is spoken of as *carding* and *spinning*. There are practically three large divisions in manufacturing yarn from the raw fiber: First, cleaning

a. *b.* *c.* *d.*

WOOLEN AND WORSTED YARNS MAGNIFIED

a. Fine Worsted Yarn.
b. Fine Woolen Yarn.
c. Coarse Worsted Yarn.
d. Coarse Woolen Yarn.

the fiber, removing dirt, grease, etc.; second, carding, reducing the clean matted fiber into a strand about an inch in diameter; third, reducing the thick strand to a thread of proper size by a series of operations of *drawing* (pulling out) and *twisting*.

Woolen and Worsted Yarns. Wool may be separated into two classes of thread-like forms called yarn *worsteds*

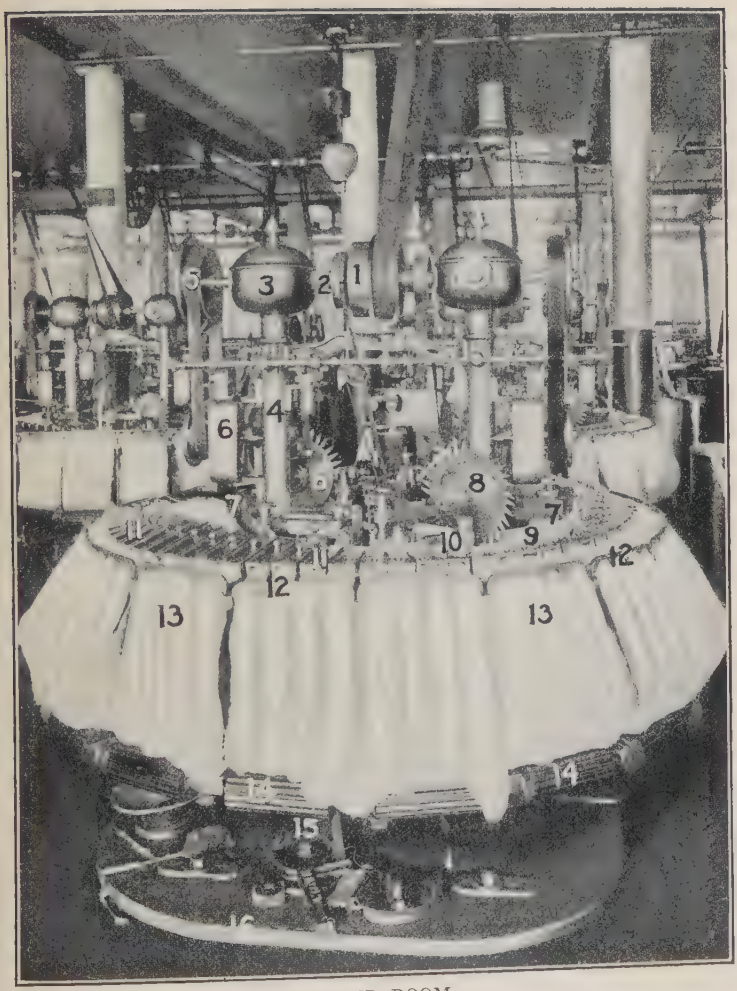
and *woolens*. Examine a piece of thread in a serge (worsted fabric) and also one in a tweed (woolen fabric) and note that the yarn (worsted) in the serge is smoother, thinner, and has more twist than that in the tweed (woolen yarn). Hence, the manufacturing operations for making worsted yarn are different from those required for woolen yarn. In fact, the character of the wool used in worsted also differs.

Carding. After the wool is washed it undergoes a number of operations before it is finished into worsted or woolen yarn.[1] The first step in the manufacturing of worsted yarn is to pass the washed wool through a worsted card, which consists of a number of cylinders covered with fine wire teeth mounted on a frame. The effect of these cylinders on the wool is to disengage the wool fibers, make them straight, and form a "sliver" or strand. It is now ready for the combing machine.

Combing. The process of combing consists of subjecting the card sliver to the operations of the automatic wool comber, which straightens the fibers and removes all short and tufted pieces of wool. Combing makes sure that every fiber of the wool lies perfectly straight, and that all fibers follow one after the other in regular order.

Comb. A comb is a complicated machine. The principal feature is a large metal ring with rows of fine

[1] The distinct difference between worsted and woolen yarns is that worsted yarn is made of fibers that are parallel, while the fibers of woolen yarn run in all directions. The worsted yarn is stronger.



COMB ROOM

1. Driving pulley on horizontal shaft (2).
3. Boxes containing bevel gears.
4. Pillars.
5. Driving pulley for dabbing motion.
6. Boxes containing dabbing-brush mechanism.
7. Dabbing brushes.
8. Star or stroker wheels.
9. Large circle containing rows of pins.
10. Drawing-off apron and rollers for large circle.
11. Brass boxes or conductors.
12. Guides for comb ball ends.
13. Comb balls (4 ends each).
14. Fluted wooden rollers on which comb balls rest.
15. Comb leg (4 in number).
16. Foundation plate.

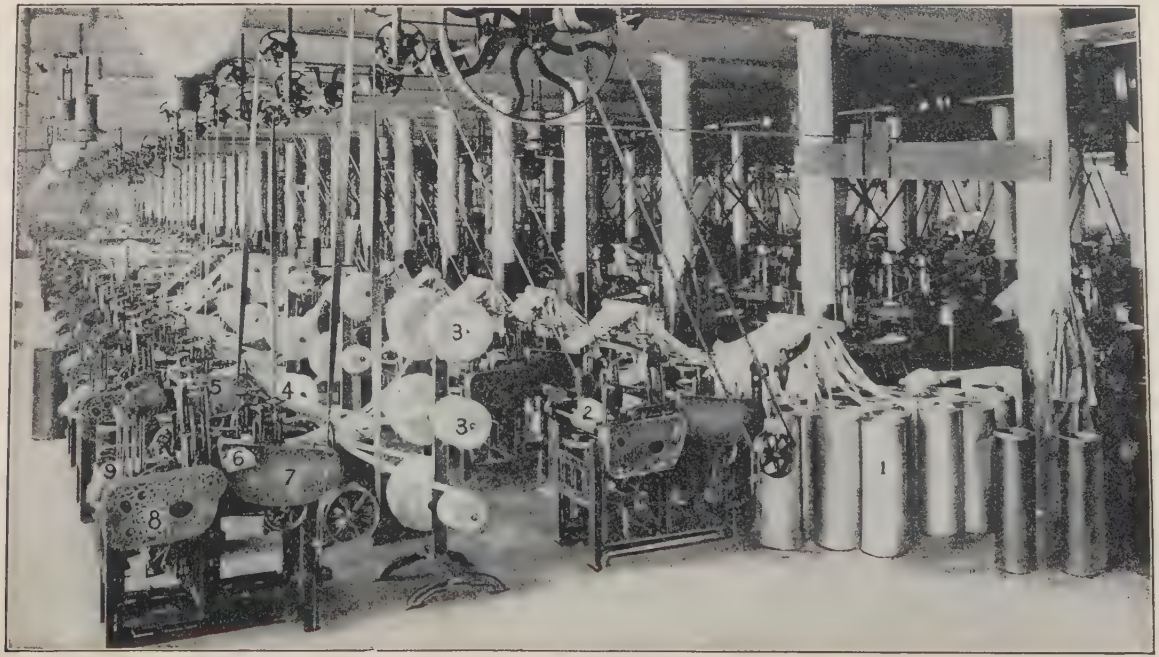
steel pins (pin circles), which are made to revolve horizontally within the machine. By various devices the wool is fed into the teeth of the ring in the form of tufts. The fibers of the tufts by an intricate process are separated into long and short lengths, and a set of rollers draws each out separately and winds it into a continuous strand called "tops." On leaving the comber, the wool is free from short fibers, specks, and foreign substances, and presents a fine, flowing, and lustrous appearance. The short, combed-out wool is called *noils*, and is used in making carpet yarns, ground up into shoddy stock, or utilized in spinning fancy yarns.

Worsted Tops. American textile manufacturers are finding it advantageous to have their combing done by those who make the work a specialty rather than to do it themselves. Tops are sold to worsted spinneries.[1]

In a strand of combed wool, called top, no single fiber lies across the strand; all lie in the direction of the length. This order is preserved until the fibers have been converted into yarn, which is accomplished by passing through "gill boxes."

These gill boxes are machines with bars of iron having upon their surface two rows of minute steel pins, by this means kept perfectly straight. The bars on which they are placed are worked on screws between two sets of rollers. The wool enters between the first set of rollers, and, as it passes through, is caught by one of these gills that is raised up for the purpose, being succeeded by others as the rollers revolve. These gills are moved forward on screws in the direction of the other set of rollers, and the pins in

[1] Mills that manufacture worsted yarn.



GILLING

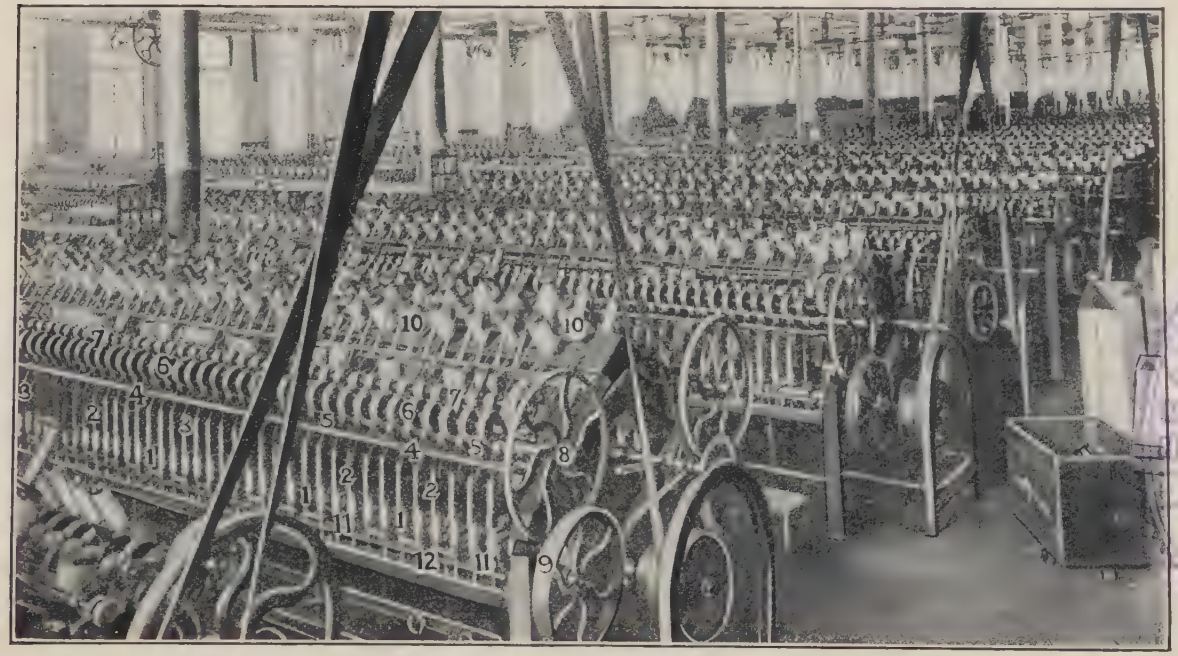
1. Cans containing Comb Ends or Sliver
2. Balling Head.
3. Stock from Balling Head No. 2.
4. Screws for applying pressure to Back Rollers.
5. Screws for applying pressure to Front Rollers.
6. Faller Screws situated between No. 4 and No. 5.
7. Guard for covering gears which drive Back Rollers.
8. Guard covering gears which drive Balling Head.
9. Balling Head.

the gills always keep the fiber perfectly straight. The second set of rollers is termed the draft rollers, since by them the wool, after passing through the front rollers, is drawn out and reduced in thickness. This is accomplished because the second rollers revolve at a higher rate of speed than the first rollers, the speed being regulated according to the length of the wool, and the thickness of the yarn to be produced. These gills are used in the production of worsted yarn until the size of the rope of wool has been so reduced and twisted that there is no chance of any fiber getting crossed or out of the order of straightness. A worsted yarn is, consequently, a straight yarn, or a yarn produced from perfectly straight fibers.

The combing of wool may be dispensed with in some cases, although such a yarn is not in common use. When combing is dispensed with, the gills, in connection with the draft of the rollers, make the fibers straight and produce a worsted yarn, although such yarn has a tendency to be uneven and knotty.

Before the wool can be spun it must be made into roving of a suitable thickness. This is done by passing it, after being combed, through a series of operations termed drawing, whose functions are to produce a gradual reduction in thickness at each stage. Although the number of machines varies according to the kind of wool to be treated, still the same principle applies to all.

Spinning. The process of spinning is the last in the formation of yarn or thread, the subsequent operations having for their object the strengthening of the yarn by combining two or more strands and afterward arranging them for weaving or for the purpose for which the yarn is required. It is also the last time that the fibers are mechanically drawn over each other or drafted, and this is invariably done from a single roving. The humidity and temperature of the spinning room must be adjusted to conditions. Each spinner is provided with a wet and dry thermometer so that the



WORSTED SPINNING. "BRADFORD SYSTEM"

1. Bobbins containing Worsted Yarn.
2. Conical shape caps placed on top of spindles.
3. Tin Wings fastened to Eyeboard. (passes to the bobbin.
4. Eyeboard containing pot eyes, through which yarn
5. Scratch fluted front rollers.
6. Leather covered Pressing Rollers for No. 5 Rollers.
7. Smooth metal Pressing Rollers for Back Rollers.
8. Large Front Roller Gear.
9. Pulley for driving Twist gear. (negs.
10. Spools of Roving held by a series of
11. Spindle bands.
12. Sifter plate or rail.

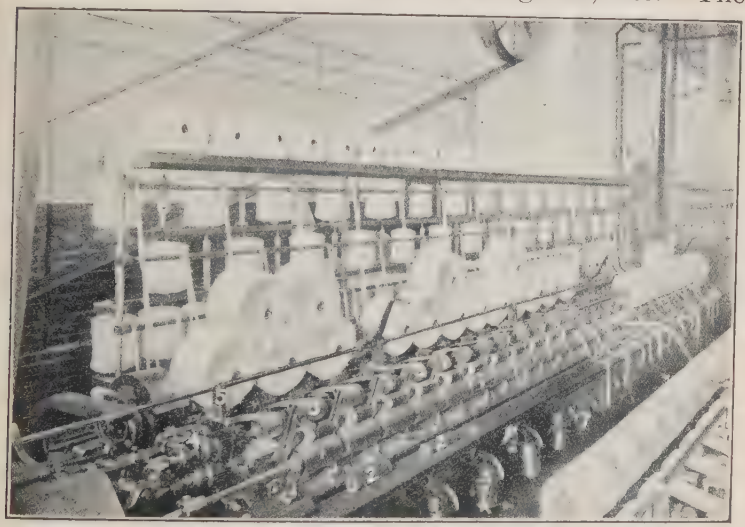
best temperature can be ascertained. The most suitable heat and humidity can only be obtained by comparison and observation. A dry and warm atmosphere causes the wool to become charged with electricity and then the fibers repel each other.

Worsted yarn is spun by two different methods, known respectively as the Bradford or English system and the French system. The difference in these systems of spinning worsteds lies principally in the drawing and spinning processes, a radically different class of machinery being used for each. The combing process is practically the same in both cases, but the wool is combed dry for the French system, and by the English method the stock is thoroughly oiled before being combed. The result of the English method is the production of a smooth, level yarn in which the fibers lie nearly parallel to each other. The yarn made according to the French system is somewhat fuzzier and more woolly. On account of the absence of oil, the shrinkage of French spun worsted is considerably less than that made by the Bradford system.

The French system of worsted yarn is used to utilize short wool fibers for making a soft worsted yarn. The yarn is spun on mules or spinning frames, which give a softer feel to the yarn. It is used for ladies' dress goods and knitted fabrics.

Characteristics of Worsted Yarn. The unique structure of worsted yarn makes it invaluable in the production of textile fabrics in which luster and uniformity of surface are the chief characteristics. The methods

by which worsted is formed render it capable of sustaining more tension in proportion to its size than the pure woolen yarn. This feature, combined with its lustrous quality, gives it a preëminent position in the manufacture of fine coatings, dress goods, etc. The



FRENCH SPINNING

1. Balling heads.
2. Bobbins upon which stock is wound.
3. Rub or condenser aprons.
4. Gearing for driving rub motion.
5. Shipper rod and handles.
6. Bobbins held in place in creel by skewers.
7. Weights with system of levers for applying pressure to rollers.

method of arranging the fibers in the formation of a woolen yarn is such as to produce a strand with a somewhat indefinite and fibrous surface, which destroys to a large degree the clearness of the pattern effect in the woven piece. In the construction of worsted yarn the fibers are arranged in a parallel relationship to each other, resulting in the production of a smooth,

hard yarn having a well-defined surface; hence weave-ornamentation of a definite or marked type is possible by its use. There is, in a word, more scope for pattern effect, since the level and regular structure of the yarn imparts distinctness to every part of a woven design. From this peculiarity arises the great variety of effects seen in the worsted dress fabrics, coatings, trouserings, etc., both in colored patterns and in fabrics of one shade throughout.

Worsted yarn can be made of pure wool; and as a rule, the wool used in the English system is of fairly good length and uniform staple, for if otherwise it is only with difficulty that the yarn can be spun straight. Shorter wool can be combed and spun under the French system, and this is the reason why the French system of spinning is being introduced. On the other hand, in the spinning of woolen yarns great length of staple is not essential, for the machinery employed will work the small fibers.

Uses of Worsted Yarn. Worsted yarn may be used in any of the following fabrics:

1. Combed wool yarn for ornamental needlework and knitting, as Berlin, Zephyr, and Saxony wools.
2. Cloth made from combed wool not classified according to material.
   - *a.* Fabrics of all wool — serge, bunting, rep, dress goods, with weave effects.
   - *b.* Wool and cotton — union goods, serge linings.
   - *c.* Wool and silk — rich poplin, pongee, henrietta, bombazine.
   - *d.* Alpaca and mohair — alpaca, mohair dress goods, lusters, braids, laces.

Count or Size of Yarn. The fineness or coarseness or size of yarn is expressed in numbers according to a system based on the number of hanks to the pound. For example, the counts of worsted yarn are based on the number of hanks in one pound, each hank containing 560 yards. Thus No. 30 worsted yarn consists of 30 hanks of 560 yards each, or 16,800 yards to the pound.

Vigoureux Mixtures. There is a great demand for worsted fabrics of mixed color. These fabrics are produced from yarns of various mixtures. The yarns are made by two methods: *Blending* of various colored worsted tops or slivers; that is, various colored worsted tops are passed through the gill boxes, drawing, and spinning frames, so that the different parts of the wools are thoroughly mixed, resulting in a composite color. Sometimes fiber yarns produced by blending are blotchy in appearance, due to the fact that all the wool has not been intimately mixed. To overcome this weakness a new method of producing " mixture colors " has been invented, called *vigoureux printing.* This method consists in printing, and not dyeing, the slivers with bands of colors by means of fluted rollers. These rollers are interchangeable, producing various percentages of colored and white slivers as desired. Experience shows that it is not possible to use more than one color on the sliver. If it is desired to have several colors in the mixture, it has been found less expensive to print the various colors on separate slivers and then blend them in the gill boxes.

History of Woolen Fabrics. Woolen fabrics were worn by the early inhabitants of Persia and Palestine. The Persians were noted for the excellent fabrics they wove from wool. Even the Hebrews of an early date were very skilful in weaving woolens.

The early Romans were a race of shepherds and the women of higher classes wove the cloth in their own homes. When Caesar invaded England, he found in the southern part of the island people acquainted with the spinning and weaving of wool and linen. With the downfall of Rome, the art of weaving cloth in Europe was almost lost, and people again wore furs and skins.

By the end of the eleventh century English cloth manufacturing had begun to revive. In the northern part of Italy certain Italians had flocks of sheep and obtained very fine wool, and the people of Flanders continued to develop skill in weaving during the Dark Ages.

In the twelfth century the woolen manufactures of Flanders had grown to be of great importance, and some of the finest goods were shipped from there to many countries.

In England, up to the time of Edward III, in the fourteenth century, the wool produced was exported to the Netherlands, there to be woven into cloth. Edward III invited many of the Flemish weavers to come to England to teach the English people how to make their own cloths. Edward was called the "royal wool merchant" and also the "father of English commerce." During Elizabeth's reign in the sixteenth century the chief article of export was woolen cloth. In 1685 the Huguenots, who were driven from France, went to England to settle. These people were noted for their skill in weaving.

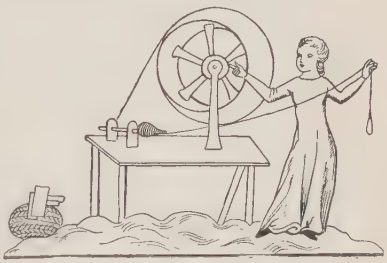
SPINNING WHORL

One of the earliest devices used for spinning

History of Carding and Spinning. Spinning and weaving are two of the earliest arts practiced by man. Yarn for the making of cloth was spun in the earliest times by the use of the distaff and spindle. The spindle was a round stick of wood a foot or less in length, tapering at each end. A ring of stone or clay was placed on the spindle to give it steadiness and momentum when it revolved.

At the top of the spindle was a slit or notch in which the yarn was caught. The distaff was a larger, stouter stick, around one end of which the material to be spun was wound in a loose ball. The spinner fixed the end of the distaff under her left arm so that the coil of material was in a convenient position for drawing out to form the yarn. The end of the yarn, after being prepared, was inserted in the notch, and the spindle set in motion by rolling it with the right hand against the leg. Then the spinner drew from the distaff more fiber, which was formed by the right hand into uniform strands. After the yarn was twisted, it was released from the notch and wound around the lower part of the spindle.

In order to spin yarn by the primitive spinner, it was necessary for the fiber to have sufficient length to enable it to be manipulated, drawn over, and twisted by the fingers. It is noted that the yarns for the gossamer-like Dacca muslins of India were so fine that one pound of cotton was spun into a thread 253 miles long. This was accomplished with the aid of a bamboo spindle not much bigger than a darning needle, which was lightly weighted with a pellet of clay. Since such a slender thread could not support even the weight of so slight a spindle, the apparatus was rotated upon a piece of hollow shell. It thus appears that the primitive spinners with distaff and spindle had nothing to learn in point of fineness from even the most advanced methods of spinning by machinery.



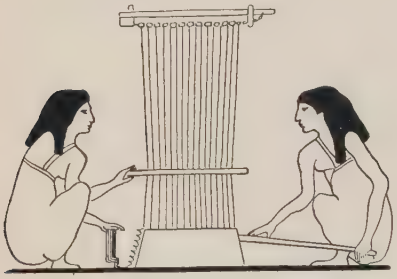
HAND SPINNING

From a Fourteenth Century MS. in the British Museum

Certain rude forms of the spinning wheel seem to have been known from time immemorial. The use of the wheel in Europe cannot, however, be dated back earlier than the fifteenth century. In the primitive wheel the spindle, having a groove worked in its whorl, was mounted horizontally in a framework fixed to the end of a bench. A band passed around the whorl and was carried around a large wheel fixed farther back on the bench, and this

wheel, being turned by the hand of the spinner, gave a rapid rotation to the spindle.

The fibers to be spun were first combed out by means of carding boards — an implement of unknown antiquity, consisting of two boards with wire teeth set in them at a uniform angle. The fiber to be carded was thinly spread upon one of the boards, and then the other was pushed backward and forward across it, the teeth of the two overlapping at opposite angles, until the fibers were combed out and laid straight in parallel lines. The fibers were then scraped off the boards in rollers or "cardings" about twelve inches long and three-quarters of an inch in diameter. An end of the carding was then attached to the spindle and the wheel set in motion. The carding itself was held in the hand of the spinner and gradually drawn out and twisted by the rotation of the spindle. As soon as a sufficient length had been attenuated and twisted to the required fineness, the thread so produced was held at right angles to the spindle and allowed to wind up on it. But for fine spinning two operations of the wheel were generally necessary. By the first spinning the fibers were drawn out and slightly attenuated into what was called a roving, and by the second spinning the roving itself passed through a similar cycle of operations to bring it to the required degree of attenuation and twist.



AN ANCIENT LOOM
From an Egyptian Monument

Many improvements in the primitive wheel were introduced from time to time. In its later developments two spindles were employed, the spinner being thus enabled to manipulate two threads at once, one in each hand. This was the latest form of the spinning-wheel, and it survived until it was superseded in the eighteenth century by the great series of inventions which inaugurated the industrial revolution and led in the nineteenth century to the introduction of the factory system.

Richard Arkwright, who has been called the "father of the factory system," built the first cotton mill in the world in Nottingham in 1769. The wheels were turned by horses. In 1771 Arkwright erected at Crawford a new mill which was turned by water power and supplied with machinery to accomplish the whole operation of cotton spinning in one mill, the first machine receiving the cotton as it came from the bale and the last winding the cotton yarn upon the bobbins. Children were employed in this mill, as they were found to be more dexterous in tying the broken ends. As the result of this great invention, factories sprang up everywhere in England, changing the country scene into a collection of factories, with tall chimneys, brick buildings, and streets. From 1780 to the middle of the nineteenth century the development of inventions was rapid.

EARLIER SPINNING AND WEAVING
From a Fifteenth Century MS. in the British Museum

Woolen Yarn. In manufacturing worsted yarn every necessary operation is performed to arrange the wool fibers so that they will lie smoothly and parallel to each other. In the case of woolen yarn every operation is performed so as to have the fibers lie in every direction and to cross and overlap each other.

To produce yarn of the woolen type a set of machinery entirely different from that used in worsted manufacture is necessary. The wool is carded, but no

attempt is made to get the fibers parallel. The reduction in thickness of the sliver is not brought about upon the so-called drawing frame, but by a mule frame where the drawing and twisting are done at the same operation. As neither combs nor gills are employed, there is not the same smooth, level yarn, but one which has a fringe-like covering or fuzzy appearance that makes woolen yarn so valuable.

In the sorting of wool we saw that the shorter staples were classed as clothing wools. To these must be added the noils from worsted combing, yarn waste, and wool reclaimed from off-sorts, as well as wool extract made from rags, before we have the raw material for the woolen industry. Whereas we found that combing wool had to be left in the grease until it could be carded immediately after scouring, the maker of woolen yarn will buy wool that has been scoured months before. Most of the wool that is scoured by or near the growers finds its way into the woolen industry for this reason. The scouring given to clothing wool varies only in that it is more violent than that given to combing wool, and is frequently accompanied by carbonization to remove vegetable matter. The first process after scouring is blending. When the desired mixture of various grades, kinds, and colors of wool, wool extract, or cotton has been effected, the resulting heterogeneous mass is put through the first of several carding processes. From now on the desire of the woolen yarn manufacturer is diametrically opposed to that of the worsted comber. He wants to open out the fibers, and he wants them to lie in all directions. He does not want uniformity. He wants just the opposite. His yarn must have a certain amount of strength, but it must have, first of all, felting properties, so that when the cloth is finished the various threads will merge and interlock. As might be expected, therefore, the carding process is very much more violent.

Blending. Shoddy or remanufactured wool is used only in woolens and cannot be used in worsteds. The

process of mixing the remanufactured wool and virgin wool is called *blending*. The remanufactured wool is never dyed, but the virgin wool is dyed to agree with the shoddy.

Pure wool of but one quality is not often used in the production of woven fabrics, so, before the raw material is ready for spinning into yarn, or for other processes by which it is worked into useful forms, it is blended. Wools are blended for many reasons (among which cheapness figures prominently), the added materials consisting usually of shoddy, mungo, or extract fibers. Ordinarily, however, blending has for its object the securing of a desired quality or weight of cloth. The question of color, as well as quality, also determines blending operations, natural colored wools being frequently intermixed to obtain particular shades for dress goods, tweeds, knitting yarns, etc. Stock dyed wools are also blended for the production of mixed colors, as browns, grays, Oxfords, etc. There is practically no limit to the variety of shades and tints obtainable by mixing together two or more colors of wool. The various quantities of wool to be blended are spread out in due proportion in the form of thin layers, one on top of the other, and then passed through a machine called the teaser. The teaser consists of a combination of large and small rollers, thickly studded with small pins, which open the wool, pull it apart, and thoroughly intermix it. A blast of air constantly plays upon the wool in the teaser and aids the spikes and pins in opening out the fibers. The material is subjected to this operation several times and is finally delivered in a soft, fleecy condition, ready to be spun into yarn.

The operation is as follows:

Carding. After washing the material for woolen yarn, it is passed through three carding processes, and from the last of them is taken direct to the spinning frame to be made into yarn. The object of woolen carding is different from carding in any other textile manufacture.

In most processes of carding the fibers are subjected

to a " combing " principle, and the aim is to lay the fibers parallel. Woolen carding aims to open the raw wool fiber, and put it in a perfectly loose condition, without leaning toward any definite arrangement.

The carding machines are called, respectively, first, second, and third breaker. Each machine consists of a complicated series of card-covered cylinders of different sizes, running at different rates of speed — sometimes in the same and sometimes in an opposite direction. These rollers take the wool from one another in regular order until it is finally delivered from the third breaker in a soft, fluffy rope or roll called a sliver. This sliver is wound on a bobbin and taken from the card to the mule spinning frame, where it is passed through rolls, and the sliver attenuated by means of a traveling carriage.

Count. In the case of woolen yarn there are numerous systems for denoting the count, varying with the locality in which it is spun and the character of the product. In the United States there are two systems employed, but the one in most general use is known as " American run counts." This is based on the number of " runs," each containing 1600 yards to the pound. Thus, a yarn running 8000 yards to the pound is called a 5 " run " yarn, a yarn with 5200 yards to the pound is equal to a $3\frac{1}{4}$ " run."

In the vicinity of Philadelphia woolen yarn is based on the " cut," each cut consisting of 300 yards, and the count is the number of cuts in a pound. Thus, No. 30 cut yarn consists of 9000 yards to the pound. No. 15 contains 4500 yards to the pound.

Woolen yarn is suitable for cloths in which the colorings are blended and the fibers napped, as exemplified in tweed, cheviot, doeskin, broadcloth, beaver, frieze, chinchilla, blanket, and flannel.

QUESTIONS

1. Name the three divisions or processes for making raw wool or material into yarn. Describe each.
2. What are the chief characteristics of a woolen yarn? Of a worsted yarn?
3. Draw a sketch of a woolen yarn; of a worsted yarn.
4. What is the difference between carding and combing?
5. Define: Noils, top, sliver, roving.
6. What is the difference between the English (Bradford) and the French system?
7. Name some of the uses of yarn made by the English system; some for that made by the French system.
8. How is the fineness or size of a worsted yarn expressed?
9. (*a*) What is a hank?
   (*b*) How many yds. in $\frac{3}{4}$ lb. of 36's worsted?
   (*c*) How many yds. in 1 lb. of 2/32's worsted?
10. (*a*) What is a mixture fabric?
    (*b*) Describe fully the vigoureux process of dyeing and state the advantage of it over other ways of dyeing.
11. Give a brief history of spinning.
12. Name the father of the factory system.
13. State why different operations are necessary in making worsted yarn and woolen yarn.
14. (*a*) What is blending? (*b*) Why is shoddy used in wool yarn manufacture and not in worsted manufacture?
15. Explain the steps in making woolen yarn.
16. What is the method of describing the fineness or count of woolen yarn?
17. (*a*) What is a run of woolen yarn?
    (*b*) How many yds. in one pound of 9's run woolen?
18. Name some of the uses of woolen yarn.
19. Describe briefly the history of the woolen industry.

CHAPTER VI

MANUFACTURE OF CLOTHS

There are really four distinct systems of manufacturing cloth, according to the structure or the way it is put together: (*a*) Felting; (*b*) weaving; (*c*) knitting; and (*d*) plaiting.

Production of Cloth by Felting. Felting is the process by which cloth is made by pressing slivers of wool into layers and then pressing the layers together. This method of producing cloth is very serviceable, as it makes it possible to waterproof layers of cloth of any thickness.

History of Felting. True or pressed felt is probably the oldest form of textile fabric used by mankind. The first manufacturing instinct of prehistoric man seems to have been along the line of providing body covering, and there is no doubt that he gradually came to notice that wool shed by wild sheep matted or felted together and could be used as a covering for himself and his mate. Later, as his intelligence developed, he reproduced the felting action by pounding with his crude club wool spread out on a flat stone, thereby establishing the first textile mill. Whatever may be the origin, however, the art of felt making is extremely old, antedating spinning and weaving.

Modern Europe developed the art of making felt along with other textile industries. In this country we began to go to the front about fifty years ago, when awards were made to American manufacturers at Vienna and Paris. The pressed felt industry of this country has increased steadily since then.

How Felt Cloth is Produced. We saw in Chapter II that wool fiber when examined closely under a microscope is covered more or less with little scales, all pointing in one direction. It is these scales combined with the curling tendency of the fiber under the influence of heat and moisture that produce the felting qualities of wool. Other animals' hair when magnified shows coarse scales, and will felt in the same way when properly treated. Cotton, on the other hand, when under the microscope shows a smooth, flat, twisted form and can be felted only when properly mixed with wool. It is possible to felt such a mixture with as little as 12 per cent to 15 per cent of wool, but 20 per cent and over is easier to work. Good felting stock includes all grades of short staple wool, goat hair, cow hair, China hair, cotton, shoddy, mill waste, card strippings, etc. These, of course, are not all mixed together, but various combinations are made in various kinds of felt. The finest and most select grades of wool are used to produce piano hammer felt, and the coarse grades of cow hair are used for insulation felts.

In the manufacture of felts for general purposes, three or four stocks are commonly combined, and sometimes eight or ten different types and kinds of fibers go into the mixture. This depends on the specifications to be met and the price of the stock. The mixture is made up in batches or lots by scattering the different lumps, layer by layer, on the floor, the same way as batches are made in woolen yarn. The mixture is then conveyed by hand to the mixing picker, from

which it is blown into the gauze room or bins. Sometimes for better mixing it is run through again. If the bins are properly located, this mixed stock is taken direct to the feeder of the breaker card. This crude practice is gradually being done away with in both woolen mills and felt mills, as a machine has been devised to eliminate this old method.

Until comparatively recent years felt making was considered to be a secret process, but like many other "secret processes" in the textile business, the principles of felt production are quite simple. The stock used in pressed felts must be mixed or blended, carded, made into a bat, hardened, fulled, dyed, dried, and finished. All of these processes, except hardening, are known in the manufacture of other textile fabrics.

Uses of Felts. The largest general use for modern pressed felt is in the manufacture of slippers and shoes. Probably 60 per cent of the output goes into footwear. Rubber boots are felt lined, and rubber shoes have soles partly composed of felt. Felt is largely used in the padding of suits and overcoats, for saddles, for weather strips to keep out the cold, for silence strips, to stop the rattle of automobile windows, and for washers to keep out the dust and retain the oil around the auto engine and running parts.

The coarser grades of felt made from cow and goat hair are used as insulators between the walls in ice houses and refrigerators and to deaden the sound between apartments. From the same material also come squares to polish plate glass. Polishing wheels,

however, are made from a finer grade of wool stock. During the War felt played an important part in the manufacture of gas masks, helmets, aviators' ear muffs, gun wads, and other special uses. A good grade of stock is required for polishing wheels, filters, and hat bodies, and the very best stock with the highest quality of work is required in piano felts. Felt for piano dampers, rails, and washers, etc., requires careful selection of stock and extreme attention in production.

QUESTIONS

1. What are four distinct types of fabrics according to structure?
2. (*a*) What is felting?
   (*b*) Name some of the properties of woolen fabrics that have been felted.
3. Describe briefly the history of felting.
4. How is a felted cloth produced?
5. Name some of the uses of felted fabrics.

CHAPTER VII

WOVEN FABRICS

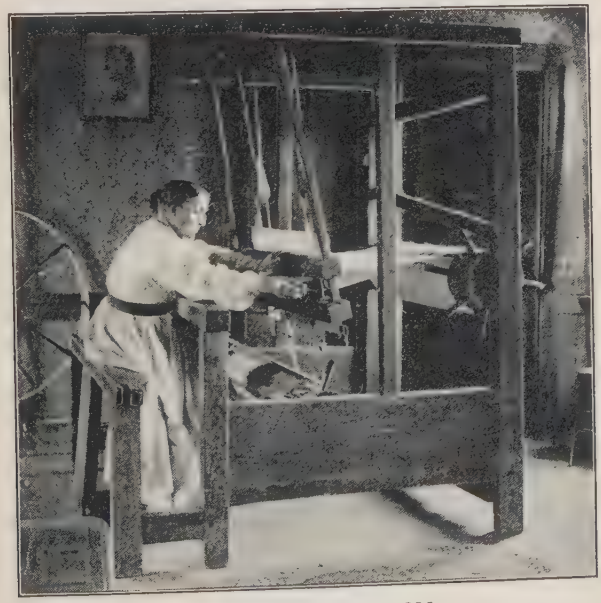
Nature of Weaving. Hold up to the light a very coarse piece of worsted fabric and note the way the threads interlace at right angles. This method of cloth structure is called weaving. The strongest and most popular method of producing cloth is by the interlacing of at least two sets of threads at right angles. It produces a fabric that is very strong and yet allows ventilation to take place, which is not true of felted fabrics.

When and where man first began to weave cloth is not known, nor is it known whether this art sprang from one common center or was invented by many who dwelt in different parts of the world. There is so great similarity in the early devices for weaving as well as spinning that by most men of science it is thought that the art must have come from a common center.

Preparatory to Weaving. In order to make woven cloth it is necessary to have the yarn arranged in a series of threads called the *warp*. This is done by arranging a series of spools containing the yarn in a frame called a *creel* and allowing them to wind in parallel lines over a wooden cylinder called the warp *beam*.

Since the yarn is wound on bobbins on the ring or mule spinning frame, it is necessary that these bobbins should be transferred to a machine called a *spooler*, where the yarn is rewound on a spool preparatory to making the warp.

Before the warp can be placed in the loom so as to



A SIMPLE HAND-LOOM

Showing frame, warp beam, cloth-roll, heddles, and reed

weave or interlace it with filling, it must be *sized*, that is, passed through a solution of starch and tallow. This is necessary for all single twist warp yarn. Its primary object is to increase the *strength* and *smoothness* of the thread, thus enabling it to withstand the strain and

friction due to the weaving operation. Other objects of sizing are the increase of the weight and bulk of the thread and the improvement and feel of the cloth. The warp is usually sized by passing it over a roller and through a bath of starch mixture. The machine for sizing is called a *slasher*. The warp is now ready to be placed in the loom.

Parts of a Woven Fabric. Every woven piece of cloth is made up of two distinct systems of threads, known as the warp and filling (*weft*), which are interlaced with each other to form a fabric. The warp threads run lengthwise of the piece of cloth, and the filling runs across from side to side. The manner in which the warp and filling threads interlace with each other is known as the *weave*. When the word *end* is used in connection with weaving it always signifies the warp thread, while each filling thread is called a *pick*. The fineness of the cloth is always expressed as so many ends and picks to the inch. It is expressed thus 84×80, meaning 84 ends and 80 picks to the inch.

Weaving Processes. In order to understand the different kinds of weaves it is necessary to know, or at least to understand, the process of forming cloth, called weaving. This is done in a machine called a *loom*. The principal parts of a loom are the *frame*, the *warp-beam*, the *cloth-roll*, the *heddles*, and their mounting, the *reed*. The warp-beam is a wooden cylinder back of the loom on which the warp is wound. The threads of the warp extend in parallel order from the warp-beam to the front of the loom, and are

attached to the cloth-roll. Each thread or group of threads of the warp passes through an opening (eye) in a wire loop, called heddle. The warp threads are separated by the heddles into two or more groups, each controlled and automatically drawn up and down by the movement of the heddles. In the case of small patterns the movement of the heddles is controlled by special devices called *cams*, which move up the heddles by means of a frame called a *harness;* in larger patterns the heddles are controlled by harness cords attached to a *Jacquard* machine. Every time the harness (heddles) moves up or down, an opening (*shed*) is made between the threads of warp, through which the *shuttle* is thrown.

The filling thread is wound on a bobbin which is fastened in the shuttle and which permits the yarn to unwind as it passes to and fro. As fast as each filling thread is interlaced with warp it is pressed close to the previous one by means of a *reed* which advances toward and recedes from the cloth after each passage of the shuttle. This is done to make the cloth firm. There are various movements of the loom for controlling the *tension* of the warp, for drawing forward or taking up the cloth as it is produced, and for stopping the loom in the case of breakage of the warp thread or the running out of the filling thread.

Weaving may be performed by hand in hand-looms or by steam-power in power-looms, but the arrangements for both are to a certain extent the same. Many different kinds of power-looms are manufactured

for producing the various classes of textiles in use at the present time. These looms are distinguished by the name of the material which they are designed to weave, as the *ribbon-loom, blanket-loom, burlaps-* and *sacking-loom, plush-loom, double-cloth loom, rug-loom, fancy cotton-loom, silk-loom, worsted-loom,* etc.

Weaving is distinct from *knitting, netting, looping,* and *braiding,* which are operations depending on the interlacing of a single thread, or single set of threads, while weaving is done with two distinct and separate sets of threads.

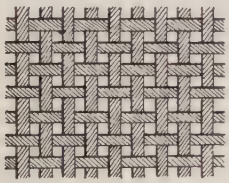
Classes of Weave. The structure of a woven fabric made by the interlacing of two sets of yarns makes it firm and more rigid than any other cloth structure, consequently while it lacks *elasticity* it holds its shape better.

The method of interlacing the filling and warp is called the *weave,* and it may vary to meet different conditions. For example, it is desirable sometimes to have a very light fabric, one that will cover the greatest area, called *yardage,* with the least amount of yarn. On the other hand, there are times when it is necessary to have a very weighty fabric or perhaps one that is to be used for lining and must be able to withstand friction.

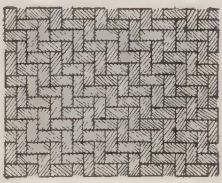
Therefore there are many hundreds of different types of weaves to meet varying conditions under which the cloth is to serve for use. It is possible for selling purposes to classify all woven fabrics into the following large divisions of weaves:

(1) Plain-weaving
(2) Twill-weaving
(3) Satin-weaving
(4) Figure-weaving
(5) Double-cloth-weaving
(6) Pile-weaving
(7) Gauze-weaving
(8) Lappet-weaving

Plain or Homespun Weave. Plain cloth is the simplest cloth that can be woven. In this weave one series of threads (*filling*) crosses another (*warp*) at right angles, passing over one and under one in regular order, thus forming a simple interlacement of the threads. It is sometimes called a plain or homespun



PLAIN WEAVE



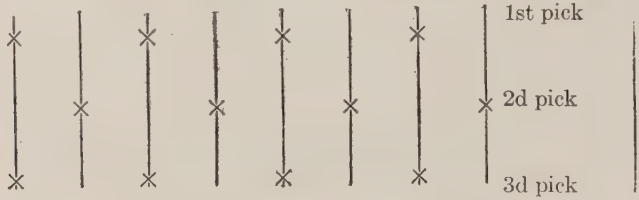
TWILL WEAVE

or tabby weave. The warp is divided into two parts: the even warp threads are in one harness and the other odd number warp threads are in the other. Two harnesses are used in the plain weave. Sometimes the method of interlacing is expressed as a fraction in which the numerator is the number of threads the filling passes under, while the denominator is the number of threads the filling passes over. The plain weave may be written $\frac{1}{1}$, " 1 up and 1 down."

The plain weave may also be represented by the following diagram:

The vertical lines represent the warp yarns, all run-

ning in a parallel direction. The filling runs at right angles to the warp. The filling passes over either the odd or even number of the warp. If the first filling thread or pick passes over the odd numbers — the *X* shows whether it passes over the warp — the second



pick thread passes over the even numbers. The third pick passes over the odd numbers in the same way as the first pick. There are two picks to the repeat or pattern of the plain weave.

This combination makes a strong and firm cloth. It gives a very light fabric, but does not give a close or a heavy fabric, as the threads do not lie as close and compact as they do in other weaves. In plain cloth, if not fulled or shrunk in the finish, the result is a fabric perforated with large or small openings (see illustration on page 73) according to the size or twist of yarn used. If heavy or coarse threads are used, the perforations will be large; if finer threads, the perforations will be smaller.

This weave is used in the production of sheeting, muslin, lawn, gingham, broadcloth, taffeta, etc. It is commonly used when the cloth is intended to be ornamented with printed patterns. In weaving cloth of only one color but one shuttle is used, while for

MAIN WEAVE ROOM

1. Warp beam containing warp.
2. Lease Rods.
3. Harnesses.
4. Dobby Head motion to lift harnesses.
5. Jacquard Head motion.
6. Cards containing design—working in connection with Jacquard Head motion.
7. Whip Roll.

the production of checks, plaids, etc., two or more shuttles are required. These are called *box-loom* effects, because the portion of the loom holding the shuttles is called the *box*.

The plain weave was no doubt the first weave invented. Originally it was woven without any pattern, but as time went on inventive weavers found that decorations might be produced in the plain weave as follows:

(1) Introducing in the warp at stated distances a colored yarn which when woven produced a *stripe effect*.

(2) Similar colored yarn in both warp and filling would produce a *check* or *gingham* effect.

(3) Introducing a thicker yarn at stated distances in the warp produced when woven a *cord effect* in the *warp*, like a *repp*.

(4) Similar introduction in the filling would cause a *cord effect* in the *filling*, producing a *poplin*.

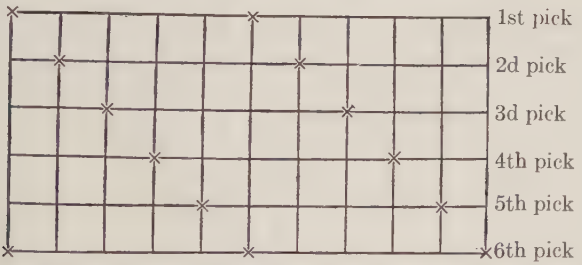
(5) Introducing crêpe yarn of left and right hand twist in the warp or filling or both would produce a *crinkled appearance* — *crêpe effect*. Similar effects may also be produced by differences in the *tension* of the warp.

Basket Weave. Since the plain weave is not decorative in itself, a combination of the plain weave is used where two or more threads instead of one interlace. This weave is very popular and is used for woolens. It is known as *basket* (*weave*) *cloth*.

Twill Weave. Various successful attempts were made to produce a stronger fabric, — one with either more ends or picks to the inch. This was done by having the pick interlace more than one thread at a time. From this formation we have the *twills* and *sateens*,

fabrics that are more decorative than the plain weave and stronger in resisting friction or rubbing strain. The characteristic of the twill is the *diagonal effect,* and that of sateen the *high luster* due to smoothness of the fabric.

This weave is used extensively in worsted suitings. It is produced by having the filling thread interlace one and then more than one warp thread. The inter-



X signifies filling thread passes over warp thread. There are five picks to the repeat or design.

lacing moves one thread to the right with each pick, as shown on the diagram above.

In this class of weaves the filling yarn or threads pass over 1 and under 2 warp threads, or over 1 and under 3, 4, 5, or 6, or over 2 or 3 and under 1, 2, 3, or 4, or over 4 and under 4, 3, 6, etc. Each filling thread does not pass under and over the same set of warp threads, as this would not give the desired interlacings. Instead the order of interlacing moves one thread to the right or left with each filling thread that is woven. If there are the same number of threads to an inch in warp and filling, twill lines will form an *angle of* 45

degrees; if the warps are closer together than the filling, the angle will be *steeper;* if the filling threads are closer together the lines will approach more nearly *the horizontal.* Different effects are obtained in patterns by variation in the size and twist of the yarn, by the use

GIRL DRAWING EACH THREAD OF WARP THROUGH THE REED AND HARNESS READY TO BE PLACED ON LOOM

A, warp beam. B, warp. C, harness frame

of heavy threads to form cords, ribs, etc., and by mixture of vari-colored materials in the yarn. Often one form of twill weave is combined with another to produce a fancy twill weave. The object of the twill weaving is to increase the bulk and strength of a fabric, or to ornament it.

Names of Twills. Twill weaves are usually named according to the number of harnesses necessary to make the pattern used in weaving. For example, in three harness twill the filling threads go under one and over two warp threads, etc. The pattern repeats itself in the fourth pick. Sometimes the terms three shaft, three end, or three leaf are used instead of three harness.

In weaving twills it is possible to have either the warp or filling on the face. To illustrate, in a four harness twill expressed as 3/1 most of the warp shows; expressed as 1/3 most of the filling shows.

The following twill weaves are commonly used:

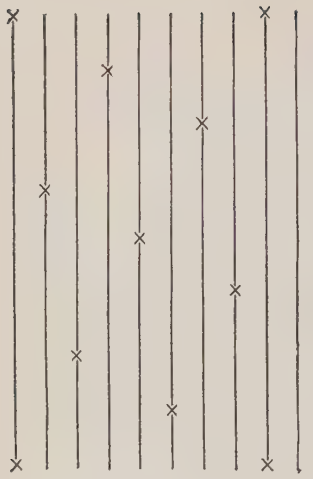
(*a*) Three shaft twill — Drilling and jeans.

(*b*) Four shaft — Blankets, cassimers, shepherd's check, double back fabrics.

(*c*) Five shaft — Doeskin, satins, sateens, venetians, drillings, diapers, and damasks.

Twills in which the warp predominates on the face are known as drills. Such goods are produced in enormous quantities and form a prominent feature in our export trade. Various types of imported cloths use the twill weave to a greater or less extent, for instance, the twilled venetian and gaberdines. The name gaberdine was originally applied to a four harness twill, closely woven, of medium twist yarn, which was afterwards piece dyed and waterproofed for raincoats.

Sateen Weave. While the twill has body and weight, it is necessary to give the yarn considerable twist in order to bring out the diagonal effect to advantage. The additional twist makes the fabric appear rough.



If the amount of twist is less and the diagonal effect is destroyed, the fabric is quite smooth and naturally reflects the light and has a distinct luster. This is the object of the *sateen weave.*

The sateen weave may be practically the same as the twill, except that the diagonal effect is destroyed. To illustrate, in a 1/7 sateen or eight leaf or eight harness sateen, we would have the following diagram:

The first	pick	goes	over	the	first	end	and	then	under	7 ends
The second	"	"	"	"	fourth	end	"	"	"	" "
The third	"	"	"	"	seventh	end	"	"	"	" "
The fourth	"	"	"	"	second	end	"	"	"	" "
The fifth	"	"	"	"	fifth	end	"	"	"	" "
The sixth	"	"	"	"	eighth	end	"	"	"	" "
The seventh	"	"	"	"	third	end	"	"	"	" "
The eighth	"	"	"	"	sixth	end	"	"	"	" "
The ninth	"	"	"	"	first		"	"	"	" "

By such a combination the continuity of the diagonal effect is destroyed. There are eight picks in the pattern. That is, there must be at least eight harnesses, one for each combination in each pick, to produce the pattern. Hence, the name eight harness or eight leaf weave.

Satin Weaves. To summarize: The object of a satin weave is to distribute the interlacings of the warp and

filling in such a manner that no trace of the diagonal (twill) line will be seen on the face of the cloth. In weaving a satin design the filling thread is made to pass under 1 and over 4, 7, 9, 11, or more if a larger plush satin is required. The raising of the warp end to allow the filling to pass under is done in such a way as to prevent twill lines from showing in the cloth. The result is that practically all of the filling is on the face of the cloth. This is called a filling-face satin weave. A warp-face satin weave may be produced by reversing the order; in this case practically all of the warp is brought to the face of the cloth. In this way a worsted warp and a cotton filling might be woven so that practically all of the warp would show on the cloth, and give it the appearance of a worsted fabric. Many classes of silk goods are made in this way, with a silk filling covering a cotton warp.

This weave produces an even, close, smooth surface, capable of reflecting the light to the best advantage, and having a lustrous appearance which makes it resemble satin cloth. Satin cloth is made of silk, using a satin weave.

Satin weaves are used very largely in producing different styles of cotton and silk fabrics, and are also frequently found in woolen goods. They are more extensively used in the manufacture of damask and table-covers than for any other class of goods. Satin stripes are frequent in madras, shirtings, and fancy dress goods in connection with plain and figured weaves.

Advantages of Different Weaves. The question may be asked, what determines the number of interlacings in a twill and sateen weave? When the filling interlaces more than one thread, it is called a *floater*. This floater is a loose thread across the warp. If the floater is very long, that is, if it interlaces very many threads, it may become objectionable — it may catch on something, tear, etc. Hence it is not feasible to have over 7 or 8 interlacing in cotton, less in worsted, and not over 15 in silk. The silk threads are smaller than cotton, hence they occupy less space, and consequently the silk floaters are not so long.

Then again, the higher the twill or sateen effect, the more threads can be compressed in a given space, hence the heavier the fabric. The weight of the fabric necessary for a given use determines the number of harnesses in the twill or sateen. Experience shows five harnesses are best for drills, sateens, etc.

A sateen fabric shows more ends than picks or more picks than ends. The smallest and most common form of sateen weave is the five harness satin. Each weave has certain advantages and disadvantages.

The *plain weave* gives the largest quantity of goods for a given quantity of yarn, because the filling interlaces every warp thread, and theoretically the width of the fabric is equal to the sum of the diameter of the warp threads plus diameter of the filling, multiplied by the number of interlacings. The twill and sateen has fewer interlacings than the plain cloth and consequently has a little less width for the same number

of ends. The plain weave gives a fairly strong fabric without decoration.

The *twill weave* gives a distinct design in itself, a diagonal effect that is attractive and is usually found in worsteds. It also gives a denser fabric than the plain weave. The *sateen weave* may give the same density as the twill, but the diagonal effect is destroyed. On account of the fewer interlacings, it produces a very smooth fabric, one that gives a high luster.

There are other weaves, such as the *Jacquard, double-cloth, pile, gauze* or *leno,* and *lappet,* all of which are based on the three fundamental weaves, and are very important.

Jacquard and Dobby Designs. The *Jacquard* weave is used to produce a fabric having a more or less elaborate woven design. The plain weave has a pattern or repeat of two picks, and it is not very difficult to have the two harnesses move alternately up and down. In making a complicated twill or sateen weave with many picks to the pattern, it is necessary to have a special attachment on top of the loom, called a *dobby,* consisting of a chain of narrow strips in which pegs are placed which indicate the pattern and regulate the movements of the harness. A fancy design may be woven into the cloth by the dobby device, and is called a *dobby* or *fancy design.* In a very elaborate design of a carpet, where there are perhaps over 500 picks to the pattern of repeat, it would be necessary to have more harnesses than the ordinary loom could accommodate.

In fancy weaving the dobby attachment is widely

used, but its range is limited, since it works with harnesses, and all threads governed by a harness must rise or fall at the same time. The utmost limit is possibly 40 harnesses, thus dividing the total warp threads into not more than 40 groups. In practice the dobby is rarely used for work requiring more than 24 harnesses, and in recent years the Jacquard has become such a common attachment that it is often employed for typical dobby fabrics of less than 24 harness construction. One reason for its use on " dobby goods " is that its method of operation puts less strain on the yarn. Jacquard looms producing the most elaborate designs have to be operated very slowly, but on less elaborate designs they can be run at good speed and produce about as cheaply as the dobby. In the case of many fancy weaves, it is impossible to determine whether they have been woven with a dobby or with a Jacquard.

Jacquard Loom. Jacquard is not a machine, but an attachment to a machine. It is employed in connection with looms, lace machines, lace-curtain machines, and braiding machines, where an elaborately figured fabric is desired. Lace, lace curtains, and braid may be " Jacquard figured," but cloth is the only Jacquard figured fabric that can be designated as " Jacquard woven."

The distinctive feature of the Jacquard attachment is the apparatus for automatically selecting warp threads and lifting any individual thread independently of all others. The fanciest fabrics thus require the use of the

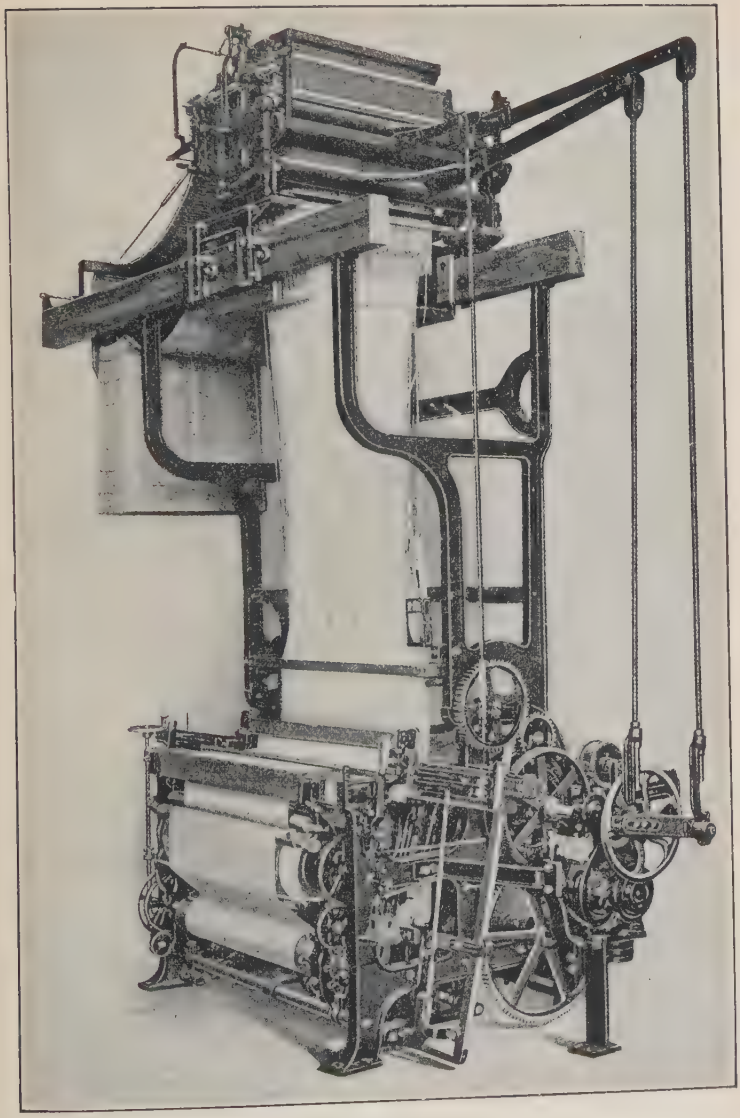
Jaquard, since its range is unlimited. It is provided with weighted strings attached to each of the warp threads. The weighted strings are controlled by wire needles, which are in turn controlled by perforated cards. The cards are perforated according to the number and location of the warp threads to be raised. Each card represents the raising of warp threads for each pick in the pattern. If there are 1080 picks in the pattern, then there will be 1080 cards, each one perforated. The cards are tied together in an endless chain combination, so the pattern may be repeated automatically without stopping the loom. Each motion of the loom changes their position and allows some needles to go through the holes in the cards, thus drawing up the warp, while others strike the card and leave the warp down. In this way the perforations in the cards determine the figure of the pattern. The Jacquard is chiefly used to produce patterns of great width in which all or most of the threads in the pattern move independently. For the weaving of elaborate effects and flowing lines it is practically indispensable.

Cotton cloths which illustrate different methods of employing Jacquard may be divided into two groups, as follows: (1) Cloths such as swivels and clipped-spot fabrics where the Jacquard is used to lift the extra threads used in the design, and (2) a larger group, embracing ordinary Jacquard-woven fabrics made without extra threads. This latter group includes a wide range, from typical dobby goods to those of the most elaborate character.

Brocaded sateens are usually light weight five harness sateens, ornamented with Jacquard woven figures in raised effects. This cloth is mainly used as dress fabrics and may be bleached, piece dyed, printed, or mercerized. It is imported from England and France.

Double Cloth. Examine a piece of heavy overcoating. Notice the side pick and face of the cloth — tear it apart and note how it is attached. A very heavy fabric, such as is used in making ulsters, weighing 24 oz. or more to the yard, is usually woven as two separate fabrics, and then connected by threads. Consequently a double cloth must have more than a single warp and single filling.

The name double cloth is applied to fabrics produced by combining two single cloths into one. Each one of these single cloths is constructed with its own systems of warp and filling, the combination being effected in the loom by interlacing some of the warp and filling threads of one cloth into the other cloth at certain intervals, thus fastening them securely together. The reasons for making double cloths are many. Sometimes it is done to reduce the cost of heavy weight fabrics by using cheaper materials for the cloth forming the back. It may be used to produce a double-faced fabric. It allows great freedom for the formation of colored patterns which may or may not correspond in design on both sides. It is the basis of tubular weaving such as is practiced for making pillow cases, pockets, seamless grain bags, etc. More frequently the object is to increase the bulk or strength of certain kinds of



JACQUARD SILK LOOM

fabrics, such as heavy overcoatings, cloakings, pile-fabrics, golf-cloth, rich silk, etc. A double cloth may include: (*a*) Two warps and two fillings; (*b*) two warps and a single filling.

Piqué Weave. Piqué is woven with a double set of warp and filling threads, therefore it may be considered a double cloth. The warp and the filling which form the surface of the cloth are usually relatively finer and of higher quality. The coarser threads used as back warp and back filling are normally about half as numerous as the face warp and filling. The former (back warp) interlaces or blends with the surface filling only in the sunken lines; the latter (back filling) interlaces only with the back warp. In the finer and heavier grades an additional set of filling (called wadding or stuffing threads) is inserted between the sunken lines and serves to fill out the welts. Piqués are also woven in figures in place of ridges. In these the back warp threads do not interlace with the face filling in straight lines, the blending points being used to form figures. This is the method used in weaving the Marseilles quilt.

Bedford Cord Weave. Bedford cords are more popular than piqués because they are less costly to weave. The name "piqué" is often applied to them. They are not so easily adapted to elaboration by fancy weaves, though the width of the welts can easily be varied, and they can be woven with twill or diagonal welts, and can also be woven in welts of several different colors. Bedford cords are woven with a single warp, with the exception of the warp wadding or stuffing threads, which

are usually employed in the better grades to give the cords a well-rounded effect. They can be woven with one set of filling on the face and one on the back, the latter interlacing with the warp only at the sunken lines. The usual method, however, employs only one set of filling, the threads alternating in weaving first on the surface of one cord and then floating over the back of the next. This is the most satisfactory for the weaver as it requires only one shuttle. When different color welts are desired it is necessary to use a shuttle for each one. The warp is arranged in the desired colors and the similarly arranged colors in the filling weave only on the surface of their corresponding cords, floating on the back of the others.

Pile Weave. Examine a piece of velvet, velveteen, or plush. Notice the back and the face of the cloth. Note that the upright face (called the pile) is made of threads projecting from the foundation cloth. *Pile weave* is a general term under which are classed numerous varieties of cloth woven with a pile surface, as plush, velvet, velveteen, and carpeting of various kinds. Turkish towels are an excellent illustration of pile weaving. *A pile surface is a closely set, elastic face covering various kinds of woolen, silk, and cotton fabrics, and consists of threads standing close together, either in the form of loops (uncut pile) or as erect thread-ends sheared off smooth so as to form a uniform and even surface.* In the production of a pile fabric a third thread is introduced into the weaving and formed into loops, usually by carrying it over wires laid across

the breadth of the cloth. The wires are afterward drawn out, leaving the loops standing; then the loops may be cut so as to form a cut pile, as in velvet and plush, or they may be left in their original form, as in Brussels carpet and Turkish towels. A more economical way of producing pile fabrics is to weave the fabrics as a double cloth, with a single thread interlacing both fabrics. Then the intervening thread is cut, leaving two distinct fabrics, each with a pile effect.

Lappet Weave. Examine a piece of dotted Swiss and note the embroidered design on the plain woven fabric. The weave that produces this and similar small designs is called the *lappet weave.* This weave is produced by a special device (called a *lappet*) attached to a regular loom, which affects the using of the warp threads so that the design is produced intermittently. The filling threads that do not form part of the design remain as free or loose threads on the wrong side of the cloth and are cut off by the finishing machine. Of course, these same effects may be produced by a Jacquard, but it is more expensive. Elaborate designs are beyond the range of lappet weaving, but there are many small effects that can be economically produced in this manner, such as the detached spots in dotted Swiss, and narrow and continuous figures running more or less into stripes. This form of weaving imitates embroidery and is used mainly in plain and gauze fabrics.

The above description may in a general way serve salespeople, but for stylers and designers the subject must be considered from the following point of view:

Lappet woven fabrics are often called extra-thread fabrics, and from the mill designer's point of view involve complicated structures. Extra-thread fabrics usually have a light weight fabric base, figured with heavy yarn in patterns or spots woven into the cloth at the time of the regular weaving process, with or without special loom attachments. They are used largely for ladies' and children's dresses, though special weaves are used for curtain and drapery fabrics. Practically all varieties, even those intended for curtains, are purely style fabrics. Special types and designs, including dotted goods, which are practically staple, are subject to fluctuating consumption because of changes in style. There are three distinct types of extra-thread fabrics, the *clipped spot,* the *lappet,* and the *swivel.*

Clipped Spot. The clipped-spot method of ornamenting goods by extra threads is the simplest, requiring less complicated machinery and less skilled labor. It is the method generally used. The extra decorative threads are introduced as filling by the aid of an extra shuttle, or in the case of several colors, an extra shuttle for each color. This extra filling interlaces with the warp over the space of the figure or spot, floating from figure to figure on the back of the cloth. Simple designs may be made with a dobby, the more complicated require a Jacquard. When the cloth is taken from the loom, it is run through a machine which clips the floats near the edge of the figures and shears to an even surface the resultant projecting ends. Clipped figures are not so durable as other types, as the threads are easily pulled out. Though a number of colors may be used in the production of the clipped-spot fabric, the design is limited to color stripes, fillingwise in the figure, and in addition there is considerable waste of yarn from clipping.

Lappet. This method requires a special loom attachment in the form of one or more needle bars on the lay of the loom. These needle bars carry a series of needles through which are threaded the extra warp threads, one needle for each figure. As the loom acts the needle bar thrusts the needle through the warp threads into the shed, allowing the shuttle carrying the regular filling to pass over the extra or lappet threads. The bar then raises and shifts the needles to the other edge of the design, where the

operation is repeated. The effect produced is that of zigzag lines of extra threads down the length of the cloth. In lappet weaving only one thread floats from figure to figure and there is much less wastage from clipping than in the case of clipped-spot fabrics. This style of extra-thread design has its limitations, however, as only one color can be used in a figure.

Swivel. The swivel method of introducing extra filling threads is the most complicated. It is not used in the domestic cotton industry, and abroad it is confined mostly to the hand looms of France and Switzerland. This method has the advantage of a wider range of design and color combination and can be produced with very little loss of yarn. The swivel attachment consists of a series of small shuttles which work for short spaces across the width of the cloth. After the regular shuttle carrying the ground filling has passed through the shed of the warp, a special shed is opened for the introduction of the swivel shuttles carrying the decorative yarn. By the aid of a circular system, or several moving or sliding systems of shuttles, a large number of figures may be introduced in the width of the cloth, and figures may be woven of six or more colors. In weaving ordinary dots or designs the dobby may be used for harness lifting or shedding; the more complicated require the Jacquard. Cloth decoration produced by the swivel is most permanent and has the appearance of hand embroidery.

Various kinds of cloth decoration have been put out in imitation of the woven extra-thread goods. These are mostly in imitation of the Swiss dots. One method, used mainly for dots, and to some extent for other designs, involved the pasting of designs on the surface of the cloth. These were supposed to stand laundering, but the method never came into very general use, being confined principally to dotted curtain material of inferior quality. Another imitation which has become common in the domestic market during the last season

is a dot produced on an organdy or other type of fine lawn base by machine embroidery. These are rather large dots and are easily distinguished from woven dots, as the threads run warpwise in place of fillingwise and pull the base fabric at the edges of the dot, usually showing a different thread on the reverse side.

Fancy Imported Fabrics. The clipped-spot method is the only one now used to any extent in making dotted designs. This method, not requiring any additional loom attachment, and the finishing machinery for clipping and shearing being simple, admits of high-speed production. Manufacture is confined largely to curtain material in dots and staple designs. The use of other methods has been practically discontinued in the domestic cotton-cloth industry, what little there is being confined to lappet work. The lack of production in this class of weaving in the domestic industry is in part due to the fluctuating demand for goods of this type because of changes in style. This prevents the mills from producing continuously and involves at each change the cost of changing machinery and training weavers. Under present conditions the latter is practically impossible, as weavers are scarce and not willing to weave on complicated work. In addition there is ample market for the simpler weaves, which allow continuous, large, and less costly production, leaving little incentive for domestic mills to take up swivel and lappet weaving.

Most of the extra-thread goods imported are composed of swivel-woven dress material. The basic materials are usually lawn, voile, or light-weight crêpe, usually bleached, but occasionally in colors. One type of Jacquard clipped-spot material called "Madras muslin" forms a large import. The swivel-decorated dress goods which make up the bulk of the imports of extra-thread fabrics are largely the product of hand looms located mainly in the homes of French and Swiss weavers. Imports of French swivel-woven cloths, many of which are known as *plumetis*, are usually elaborate novelty designs, in from one to six colors. A single figure, however, will seldom exceed two colors. The basis cloth is more often crêpe or voile, which may also be in

color. It would be doubly difficult for the domestic industry to compete in producing these cloths, as the hazard attached to the production of new designs is especially great, and the future market of even the more staple patterns is uncertain. They must be produced in small quantities. Small production of a color and pattern also adds to their exclusive nature. Orders will be accepted in Europe for as low as 30 yards of a pattern and color, even in special designs. The usual quantity is around 180 yards. This gives the foreign producers a market advantage, for in one instance, where a domestic manufacturer undertook to copy a rather simple import for a merchant, he stated that he could not afford to produce less than 30,000 yards of a pattern and color and was not anxious for the business.

There is less variation in the design of the Swiss swivel-woven imports. They are confined mostly to dots, though various other staple designs are produced. The Swiss dot is usually woven on a plain lawn base, bleached or piece-dyed, and may be either bleached or in color. These dotted Swisses are the most staple form of swivel-woven goods. Fashion, however, plays a considerable part in the domestic consumption. During some years they are in heavy demand, whereas another year may find only the dyed color grounds in general use. The latter was true of the summer of 1920, but other summer seasons may find all types of dotted Swisses popular or not in use at all.

Swiss dots vary in size from small dots made with 4 threads to those numbering 20 or more and larger in proportion. The largest are usually " cushion " dots, having a number of threads woven underneath the face to swell out the dot. There is a standard system of numbering the dotted Swisses. This is based on the usual 32-inch width and signifies the number of dots to this width and the number of threads to the dot, as —

No. 1104 signifies 110 dots to the 32-inch width, 4 threads to a dot.

No. 406 signifies 40 dots to the 32-inch width, 6 threads to a dot.

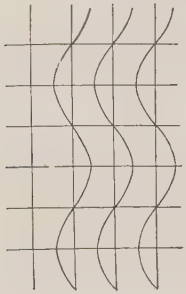
No. 3012 signifies 30 dots to the 32-inch width, 12 threads to a dot.

The number of dots in a 32-inch width varies from 40 to about 140, although an occasional fabric may have as many as 160.

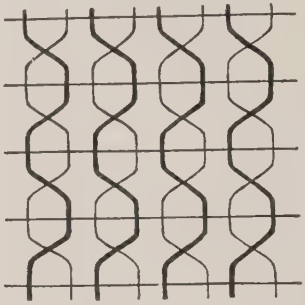
Gauze Weave. Examine a piece of marquisette and note the open work of the weave and at the same time note the strength of the fabric. A fabric with open work made on the plain weave is not very strong, hence the need of a reënforcement to give it strength. This additional strength is given to the fabric by a modified plain weave, called *gauze* or *leno weaving*, which departs from the usual straight lines of the warp, as shown in the sketch on page 96.

In gauze weaving not all of the warp threads are parallel to each other, but are made to intertwist more or less among themselves, thereby favoring the production of light, open fabrics, in which many ornamental lace-like combinations can be obtained. Two sets of warp threads are used, one being the ground warp and the other the *douping*, the latter performing the entwining process. Gauze is especially characterized by its openness and yields the lightest and strongest fabric with the least material. Gauze fabrics are designed for women's summer gowns, flounces, window curtains, etc. When gauze is combined with plain weaving it is styled *leno*. Leno weaving is slightly different, as shown in the sketch, and is produced by threading the harness in such a way that part of the warp is drawn first to one side and then to the other, forming the

gauze. When leno is very closely woven it is not satisfactory. Marquisette is usually leno-woven.



GAUZE WEAVE



LENO WEAVE

Leno-woven Fabrics. The leno is a distinct type of weave, made with the use of *doups* or half-heddles operating with standard heddles. It is often known as cross-weaving. In leno fabrics the warp ends do not all lie parallel to each other as in ordinary cloths, but part of them are twisted around warp threads to the right or left so as to give an open-work gauze effect. The gauze effect may be only in stripes on the body of the cloth, or may cover the entire fabric, the latter being known as " all-over leno work." In the part of the fabric in which the gauze effect is to be produced alternate warp ends pass through the eye of the standard heddle and through the part of the doup extending outside of the common heddle to its eye. By raising alternately the standard heddle and the douping heddle the douping thread is caused to lie on alternate sides of the ground warp thread, and it is fastened into the cloth in these positions by the passage of the filling, thus producing this gauze effect.

Marquisette is a light, sheer gauze material that is used mainly for ladies' dresses and waists; also in heavy weights, usually plain, as curtain material. " Plain " marquisettes are made of the leno weave throughout, whereas " fancy " marquisettes are fabrics of the same nature which vary the leno weave or combine leno and other weaves to form stripes or designs. The use of plain

marquisette as a dress material is limited, as it can only be produced in gauze of different degrees of fineness. Fancy marquisettes partake of the nature of novelties.

Another use of the leno which may be classed as a combination of the plain and leno weave is in producing Russian cords. These are more often used in decorating shirting fabrics and, as is mentioned in the section on shirting, employ the leno weave only in narrow stripes to form colored or mercerized cords on the surface of the otherwise plain woven fabric. In weaving Russian cords two or more heavy ground threads are used, and the leno thread, of very fine yarn, is allowed sufficient slack in weaving to work around the ground threads, that is, directly back and forth across them, and is caught in at either side by the regular filling yarn. The length of the woven leno thread is many times greater than that of the ground threads.

Madras muslin. This is a curtain or drapery material, usually of all-over leno base and Jacquard clipped-spot design. The leno is especially well adapted to clipped-spot designs where an open weave is desirable, as the twisting action holds the clipped threads in place.

The domestic marquisette is composed largely of plain gauze or net for use as dress or curtain material. The bulk of these are produced in the domestic industry which also produces a few fancy staples. In general, however, the fancy marquisette dress goods are novelties and of foreign production. This is not so true of Madras muslin. This industry is centered largely around Philadelphia. Practically all producers have their yarn spun to order, which allows them a wider range of production. Under prolonged popularity of "Madras muslin" as a curtain material domestic manufacturers have taken up the production on a rather large scale. In the simpler patterns and cheaper grades they furnish most of the consumption, making constant inroads into the market for the imported goods.

Madras muslin is imported mainly from Glasgow, Scotland, where a considerable industry has been built up. Due to the ingenuity of their designers and the care exercised in the manufacture, the Scotch have succeeded in continuing to supply a large portion of the domestic trade in this fabric.

"Take-Up." This expression is used to denote the shrinkage of yarn in weaving. To illustrate: If you were to take a piece of cloth 10 inches square and pull out some of the threads and measure them, you would probably find that they would measure 11 inches. This difference of ten per cent in length is due to the bending of the threads in weaving. When you measure a piece of yarn, you measure it as a straight line, but when you measure the same yarn in the cloth, you actually measure a line full of curves. The "take-up" is measured in per cent and expresses the shrinkage in the yarn.

Take-up is not to be confused with the shrinkage caused by the finishing processes. It depends on various factors. High tension of the warp, few interlacings, and soft, fine-count filling produce a lower percentage of take-up. On the other hand, if the interlacings are numerous, the warp tension less, or the filling heavier than the warp and hard twist, the take-up will be larger. The largest is in velvets and heavy ribbed fabrics. In fabrics which have designs formed by the warp in various weaves, as for instance satin striped grosgrain, the take-up will not be alike for all ends, and the slack and tight ends are often dressed on different warp beams or the tension equalized by reeding the ends in the dents. The approximate take-up in a cloth with many interlacings can be found by multiplying the number of picks (in an inch) by $3\frac{1}{2}$ and dividing the result by the count of the filling; in case the count is below 50's use 4 instead of $3\frac{1}{2}$.

Importance of Weave in a Fabric. Since the structure of a fabric determines its strength and shape, it is very important to know the weave of a fabric and whether it is the best fabric for a particular use. Fabrics with low construction and twist, that is, loosely

woven, with the yarn loosely twisted, will lose their shape very quickly. Therefore high construction and strong twists are necessary for firm fabrics. Loosely woven fabrics also are likely to break in washing or when subject to strain due to the friction which pushes the threads aside and produces a thin section in the fabric. This is particularly true in the satin weaves with long floats.

QUESTIONS

1. (*a*) What is weaving?
   (*b*) Describe the structure of a simple woven cloth.
   (*c*) What are the advantages of a woven cloth?
2. Where did the idea of weaving come from?
3. Define the following terms: Warp, filling, creel, warp beam, spooler, slasher.
4. (*a*) What is the object of sizing?
   (*b*) State the advantages of warp sizing.
5. State the meaning of: Ends, picks, fineness of cloth.
6. Explain the process of weaving.
7. Define the following terms: Reed, cloth-roll, heddles, cam, shed, shuttle.
8. What are the following motions on a loom: Reed, shuttle, cloth, harness?
9. Name some of the different power looms.
10. State the chief differences between: (*a*) Weaving and knitting, (*b*) Looping and braiding.
11. Name some of the principal weaves.
12. State the advantages and disadvantages of the plain weave.
13. (*a*) State the characteristics of a twill weave.
    (*b*) How is the diagonal effect produced?
14. Name some of the fabrics that are made from the plain weave.
15. Name some methods of decorating a plain woven fabric.
16. (*a*) Name some of the weaknesses of the plain weave.
    (*b*) What is the basket weave?

17. How is a twill weave named?

18. Define the following twill weaves: (*a*) 45′ twill; (*b*) herringbone; (*c*) three shaft twill; (*d*) four leaf twill; (*e*) four-harness twill.

19. Name some of the common weaves and give a list of fabrics in which they are used.

20. What are the advantages and disadvantages of the satin weave?

21. What determines the number of interlacings or harnesses of a fabric?

22. Make a comparison of the three fundamental weaves: (*a*) Plain; (*b*) twill; and (*c*) satin.

23. (*a*) Explain the double cloth weave.
(*b*) Explain the manufacture of Bedford cord and piqué.

24. How are elaborate designs woven into a fabric?

25. (*a*) What is a dobby loom?
(*b*) What kinds of designs are made in a dobby loom?

26. Describe the workings of a Jacquard design.

27. (*a*) What is a double cloth weave?
(*b*) What are the advantages of a double cloth weave?

28. (*a*) What is a pile weave?
(*b*) What are the advantages of a pile weave?

29. State how pile fabrics are made.

30. What is meant by the term lappet weave?

31. State how a dotted Swiss is made.

32. (*a*) What are the advantages of a gauze weave?
(*b*) State how the weave is produced.

33. Name gauze or leno fabrics and state their uses.

34. Describe the following: Muslin, marquisette, Madras muslin, leno weave.

35. Describe the methods of manufacturing the following fabrics: (*a*) Sheared (clipped); (*b*) lappet; (*c*) swivel.

36. Explain the method of describing the dotted designs on a Swiss.

37. State the reasons why the weave is such an important item in a fabric.

CHAPTER VIII

COLOR

Color. Color is a very important matter in textiles. In fact, in many fabrics, such as cretonnes, 90 per cent of the commercial value depends upon the coloring. For this reason it is essential to know the theory of coloring as applied to textiles.

We see textile fabrics, like all other objects, by means of what we call *light*. Light comes either from the sun, from some illuminated object, like an electric lamp, in the form of vibrations. These vibrations come in contact with the eye and give a sensation called *color*. That is, we see by reflected light.

Reflected Light. Textiles, like other objects, are seen by reflected light. For example, when rays of light fall on a fabric, like a velvet, the smooth fibers of the cloth reflect the light at the same angle at which it strikes the surface, and the fabric appears bright. If the surface of the fabric is rough or uneven, then the rays are not reflected regularly, but at different angles, and it appears dull, due to the diffused reflection. For this reason worsteds appear to "shine" and woolens do not, due to the smooth (combed) fibers in the first and the irregular fibers in the second.

Transparent Textiles. Light passes through some fabrics, such as georgette crêpe. Such fabrics are called

transparent or *sheer*. If light passes through with great difficulty, as in the case of crêpe de chine, the fabric is said to be *translucent*. When light fails to pass through a fabric, like heavy canvas, the fabric is said to be *opaque*.

Light comes to us in the form of waves vibrating at different rates. Each color is produced by waves of light that vibrate at a different rate from those of other colors, and when they are mixed in a sunlight beam they produce white light. Light may be separated into different colors or wave lengths by means of a triangular prism of glass, by which rays are refracted. In this way sunlight is separated into its component parts. The colors thus obtained make up what is called the *spectrum*.

SPECTRUM FORMED BY A RAY OF LIGHT FALLING ON A GLASS PRISM

The spectrum contains red, orange, yellow, green, blue, indigo, and violet rays. These rays are not all of the numerous components of white light, but only the standard ones, each of which is called a family color.

The colors may be divided into two classes: primary and secondary. The primary colors — red, blue, and yellow — are the fundamental colors because they cannot be produced by any mixture of other colors. The secondary colors — orange, green, and violet — may be made by mixing two of the primary colors. To illustrate: (*a*) Green is made by mixing yellow and blue; (*b*) orange is made by mixing red and yellow; (*c*) violet is made by mixing blue and red.

We associate certain sensations with color. For example, red is associated with the sun and fire, and therefore with warmth, cheerfulness, action, etc. Blue is associated with the blue of sea water and represents coldness. Yellow is associated with brilliant flowers and represents brilliancy. Colors act differently on different people, due to difference in temperament.

When the rays of light strike a textile or any other object, the vibrations of the different essential colors are either absorbed or reflected.

Every opaque object absorbs and reflects a color. A piece of red cloth looks red because it selects from white light mainly red for reflection, and absorbs the rest of the vibrations of the remaining essential colors. A textile that looks white, like a bleached linen, reflects all the rays of light. A black taffeta absorbs all the rays of light and therefore looks black. White is the presence and black is the absence of all the essential colors.

Color is measured in three ways: (1) Hue; (2) value; (3) intensity. *Hue* is the variety of color that is produced by the addition of a small quantity of one color to another. To illustrate: blue-green is a hue formed by the addition of a little blue to green. The number of hues of a color is unlimited. *Value* refers to the amount of luminosity in the color, that is, whether it is light or dark. If it is the former, we say that the value is high; if the latter, low.

The value of a color is measured by the amount of light in it. Two terms are used to express this value:

tint and *shade*. A *tint*, sometimes called a *tone*, is a color lighter or brighter than the standard. This term is applied to the normal colors when modified with white or increased light, that is, higher in value; while a shade is nearer black than white, that is, it is low in value.

The brilliancy of a color means the amount of light in it and is often expressed technically as the *intensity*. To illustrate, if we desire to determine the intensity of red, we compare the color with a standard red, which is the bright red of the spectrum.

Intensity is often used to express the strength or purity of the color. If the color is as brilliant as possible, we say that it is strong; on the other hand, if it is subdued, we say that it is dull or weak.

Black, white, and gray do not have any definite tone; hence they are called *neutral* colors. It is difficult to match them.

Grays and Blacks. Black added to a color makes it less bright, although deeper. White, on the other hand, when added or in combination with another color makes it appear lighter, but pale. Gray colors, particularly the neutral gray, when mixed with another color, usually make it appear deeper, but purer. Hence, neutral colors are used for effective backgrounds.

When we look at a color, we first determine its name (hue), then its value (high or low), and last its saturation (intensity).

Effect of Fabric on Color. The composition of a fabric has a great deal to do with the color. On subjecting cotton, silk, wool, and worsted goods to inspec-

tion, color is found to have a different tone or cast in each fabric, that is, different powers of reflecting light, due to the smoothness of the fiber. Fancy colors in cotton, while decidedly firm and clear in effect, are non-lustrous, raw, and dull in tone. Silk colorings, on the contrary, possess both compactness and brilliancy; woolen colorings have a unique depth and saturation of hue characteristic of the material employed in the manufacture of woolen goods; while worsted colorings are bright, definite, and smart in appearance.

These differences are due to the physical properties of the several fibers. Thus a filament of silk is transparent and shines like smooth glass when light falls upon it; that of wool is solid and opaque in the center, but its exterior consists of a multitude of semi-transparent scales which, when of large dimensions and uniformly arranged — as in the best qualities of wool — reflect light with a small amount of dispersion and impart to the woven material a lustrous aspect. Cotton has no such partially transparent sheath. What light is reflected is so diffused that the color is poor. Compare three plain woven crimson textures made of silk, wool, and cotton respectively. The first literally shines; luster, brilliance, and richness are the elements of its coloring. Though bright, it lacks that fullness and depth of color which belongs to the wool product, whose millions of filaments, closely compounded, all tinted alike, possess a peculiar bloom and depth of color not to be found either in the silk or cotton article. Lastly, take the crimson calico. How lacking in

warmth and richness it seems to be, after examining the woolen and silk texture! It is dull and has a raw and deficient character.

A group of colors that appear pleasing is spoken of as *in harmony*. Color harmony means simply the grouping of related colors so as to make them pleasing to the eye. Color harmony may be divided into the following classes: (1) Dominant harmony; (2) associated or analogous harmony; (3) complementary harmony; (4) contrasting harmony; (5) complex harmony.

Dominant harmonies, that is, different values of a color, such as light and dark blue, are very popular and give an air of distinction. The only possible objection to them is that they may become monotonous.

If the colors that are related to each other in the spectrum are chosen in combination, we speak of such an association as analogous harmony. To illustrate: blue, violet, and green form a very common combination illustrating this principle. That is, since there is an element of blue, there is slight contrast.

If complementary colors are in combination, there is a chance for contrast, which shows complementary harmony. To illustrate: blue green with a dash of red makes a pleasant combination illustrating complementary harmony.

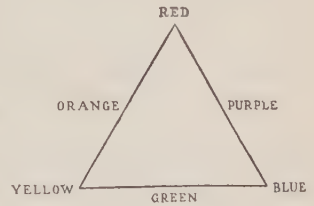
Placing a combination such as rose with a background of gray is a very common setting, illustrating the principle of contrasting harmony.

When a number of colors is chosen so that one hue

may be seen in all of them, a combination, called complementary harmony, is formed that is very attractive. This complex harmony may be illustrated by combining red, blue, yellow, etc., with a veil of orange.

Brilliant, intense colors stimulate and please us for a while, but we soon tire of them. They soon fade, spot, and become shabby. On the other hand, neutral colors are less stimulating and less conspicuous, and consequently do not become tiresome.

The best harmonies of color are found in nature — in the grass, the sky, cloud effects, birds, minerals, animals, and flowers. A study of nature will show us the primary, essential, or important, colors, — red, blue, yellow, — as illustrated in the triangle. All other colors are made from them. For example, mixing blue and red gives us purple; yellow and blue produce green; and yellow and red, orange.



The opposite colors of the triangle are complementary to each other. That is, red is complementary to green, yellow to purple, blue to orange. If we wish to soften the intensity of any color, we may combine it with its complement of the same strength.

On the other hand, if we desire to subdue a color by association, we may put a nearly related color with it instead of its complement. To illustrate, if we desire to subdue a too yellow face, we may use yellow trimmings or gold ornaments, but never purple.

Neutral values of different colors in combination appear flat and are not attractive. When a high color is used, its complement of similar strength should be used. Different hues of the same color will change each other slightly at any time. Red and purple, red and orange, blue and green should not mix together except to brighten each other.

The color of a textile fabric depends on its nature — whether silk, cotton, wool, etc. — and the light in which it is viewed. A scheme of color that is harmonious by daylight may be just the opposite at night when viewed by artificial light. Dyestuffs owe their property of color to the light that falls on them, and not to the body or substance itself. This fact may be illustrated by allowing different colored lights to fall on the same fabric and watching the colors thus produced.

Light in a store where fabrics are displayed should be diffused daylight, while in a ballroom a softer light, rich in yellow and orange tints, is preferable.

The principles of proportion, contrast, rhythm, and unity apply to color as well as design. This means that color must be properly balanced. That is, if colors differ in area, they must make up this difference in intensity in order to be in good proportion. In order to create interest there must be a difference in either hue, value, or intensity to form proper contrast. Repetition of color produces a rhythmic effect that may be pleasing. Finally, all colors must be properly blended and balanced according to color harmony in order to give unity to a design.

In the purchase of a fabric the first thing a merchant or consumer looks at is the color, or the harmony of color, in the design. Unless this is pleasing to the eye, the merchant will remain indifferent, regardless of the quality of the fabric. Strictly speaking, the buyer purchases the cloth on the merits of the color, other things being equal, — that is, if the quality and style are satisfactory, — rather than on the merits of the weave or the pattern design.

Colors are added to textiles (1) by dyeing, and (2) by printing.

Dyeing. When a fabric or fiber is impregnated with a uniform color over its whole surface, it is said to be *simply dyed.* On the other hand, if distinct patterns or designs in one or more colors have been impressed upon a fabric, it is called *printed.*

Tinting. Sometimes it is desirable to give a fabric a deeper color or to restore a faded garment. This may be done by dipping the fabric (after washing) into a solution of dye. The applications are repeated until the desired shade is obtained. This operation is called *tinting.* The color remains until the fabric is washed.

History. The art of dyeing was well known to the ancients. In the Bible we read of Jacob with his coat of many colors. Savages weave colored figures into their blankets. Each tribe has its own emblem. In fact, temperament and nationality may be indicated by colors on clothing. The people of the warmer countries have brighter colors than those who live in the

temperate and colder countries. It seems as if color is subdued as we go north.

Dyestuffs. The material used in giving coloring to textiles is dyestuff. Before 1850 most of the dyestuffs in use were of vegetable or animal origin.

Those used in textiles may be classified according to origin: *animal, vegetable, mineral,* and *artificial.* The principal animal dyestuff is *cochineal,* which is a dried insect and is used only in dyeing hand-made rugs. There are many vegetable coloring matters used in textiles, such as logwood, which is used for producing a good black on silk fabrics. During the War various pigments of arsenic were used. Very few mineral dyestuffs are used on textiles at present on account of their gritty nature, which is felt in the finished fabric. Most of the dyestuffs used are made artificially (chemically) from coal-tar preparations and are usually classified as (*a*) acid dyes, (*b*) basic dyes, (*c*) direct dyes, (*d*) sulphur dyes, and (*e*) vat dyes.

Acid Dyes are used to dye silk and wool (animal matter), but not to color cotton to any extent. They are cheap, easily applied, and fairly fast to light but not to washing.

Basic Dyes give more brilliant colors and are used more for silk than for wool. They are not fast to light. If the fabric is soaked in a chemical (called a mordant) before dyeing, this dyestuff may be used to dye cotton.

Direct Dyes, such as the " Diamond Dyes," will dye cotton, etc., directly. The colors are fast to light, but " bleed " or " run " on washing.

Sulphur Dyes are used because the colors are soft, quite fast to light, and faster to washing. They are used in hosiery.

Vat Dyes are used in printing and dyeing because they are fast to light and washing. They are used extensively in printed shirtings. They have made printed fabrics very nearly as fast as dyed fabrics. Indigo is a vat color.

Indigo is one of the most important of all coloring matters, both as regards the large quantity and monetary value of what is produced and sold, as well as for the permanence of the color which it yields. It is distinguished from nearly all other coloring matters by its insolubility in water, or in any of the ordinary solvents. The only real solvent for it is acetic acid mixed with a little sulphuric acid, from which water precipitates it unchanged, but this solvent is inapplicable for dyeing. Complete solubility is an essential condition for dyeing, and means were found to obtain satisfactory solutions of indigo by circuitous methods which involve the temporary destruction of its blue color, and a change in its chemical composition. By various deoxidizing agents, indigo blue is changed into a white substance (called indigo white), which dissolves readily in all alkaline liquids, forming a colorless or slightly yellow solution. On exposure to air or other sources of oxygen, the yarn or fabric which has been saturated with it turns blue. This is the only case in which such a method of dyeing is followed, and on that account it possesses much interest. The number of times

that a cloth is saturated with the indigo solution depends upon the shade of blue the dyer wishes to produce. The greater the number of dips and the longer time the cloth remains in the vat, the more permanent becomes the color and the darker the shade.

Vegetable dyes were formerly used, but since the coal-tar dyes have been discovered the latter are used entirely. Over fourteen thousand colors have been produced from coal tar.

Different fibers attract dyestuffs with varying degrees of force. Wool and silk attract better than cotton and linen. The attraction of cotton for coloring is generally feebler than that of wool or silk. Few of the natural dyestuffs attach themselves permanently without use of a mordant. A mordant is a substance which has an affinity for, or which can penetrate, the fiber to be colored, and which possesses the power of combining with the dyestuff and thus forming an insoluble compound upon the fiber. Cotton is dyed in an unspun state, and also as yarn or spun thread, either in the hank or skein. Silk is dyed in unspun skeins, although to a considerable extent it is also dyed in the piece.

At present there are many hundreds of dyestuffs on the market, comprising almost every shade that is likely to be required. These represent colors viewed not only in a physical or natural sense, but chemical compounds differing from each other in their qualities. It is necessary therefore in dyeing to use such dyestuffs as will harmonize not only as colors but which will work together as chemicals.

Wool Dyeing. The methods of dyeing wool differ considerably from those employed for cotton and other vegetable fibers. They may be divided into three classes: piece dyed, cross dyed, and yarn dyed.

Piece goods are those woven with yarns in their grey or natural state, and then cleansed and dyed in the piece in such colors as are required. They are woven in plain weaves and in a great variety of twills — in fact, in all styles of weaves — and are also made on the Jacquard loom. The principal fabrics in this classification are all wool serges, cheviots, hopsackings, suitings, satines, prunellas, whipcords, melroses, Venetian broadcloths, zibelines, rainproof cloths; nun's veiling, canvases, grenadines, albatrosses, crêpes, and French flannels; silk warp Henriettas, voiles, and sublimes. Whenever it is possible, it is better to dye textile fabrics in the form of woven pieces than in the yarn. During the process of weaving it is impossible to avoid getting yarn dirty and somewhat greasy, and the scouring necessary to remove this dirt impairs the color used in weaving. Piece dyeing is the cheapest method of applying color to textiles. The chief fault of piece dyeing is the danger of cloud spots, stains, etc., which do not appear in the two other methods. Then again, in the case of thick, closely woven goods the dyestuff does not penetrate into the fabric, and the interior remains nearly white.

The cloth is dyed by means of passing over a roller into a dye vat. Small pieces or "swatches" are taken from the ends of the fabric, and compared with the

pattern. For it must be remembered that no two lots of crude dyes are of equal strength, and the wools and cottons of different growths and seasons vary greatly, so that the use of a fixed quantity of dye to a given amount of goods will not always give the exact shade.

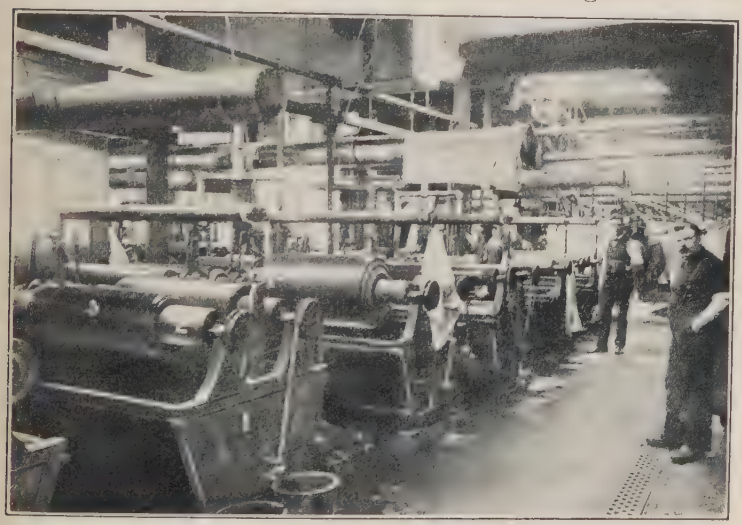
Matching Samples. In matching samples it is necessary to remember that color is greatly affected by light, surface of fabric, tone of adjacent color, etc. Although daylight is the usual standard for comparing colors, it is difficult to obtain a fair standard in this way, since the morning has a reddish or pinkish tinge, afternoon dark blue or purplish, and clouds or the shade of buildings may change the intensity of the light.

In regard to matching color, the best rule is to start with what your judgment would say to be about three-quarters enough dye to make the shade. Then match the color frequently. With wool it is only necessary to squeeze out the water, as damp wool is very nearly the same shade as dry wool, but with cotton goods the squeezed out material is more than twice the depth of shade it will be when dry. In such cases it is a good idea to pin fast to the garment a small piece of similar material, from which you can cut samples as the work proceeds, and when you have the shade nearly correct you can sample the goods themselves.

In comparing a sample with the pattern the two are placed side by side below the eyes (reflected light), and then held up to the light and the eye directed along the surface. A judgment must be formed quickly, as a prolonged gaze fatigues the eye and renders it unable to perceive fine shades of difference.

Cross Dyed. Cross-dyed goods may be described as fabrics woven with black or colored cotton warp

and wool or worsted filling and afterwards dyed in the piece. Since cotton has not the same attraction for dyestuffs as wool it is a difficult task to dye a fabric woven with cotton and wool so that both fibers will be identical in depth of color, tone, and brightness. In



DYE ROOM

1. Dye tub or vat containing dyestuffs
2. Rolls or cylinders upon which cloth is wound.
3. Cloth leaving dye tub — being wound upon No. 2 cylinder.

some cases it is possible to dye a mixed fabric at a single operation, but the usual process is to dye the wool in yarn state and then dye the warp as near the color of the wool as possible. In the weaving operation the wool is thrown to the surface. In another method the warp is dyed and woven with a white wool or worsted filling, and dyed in the piece with a dyestuff that will not affect the cotton. In this way the cotton

does not take the wool dye, but retains its original color. This class of work is generally used in mohair, alpaca, and luster fabrics, because the natural brilliancy of the luster wool, alpaca, or mohair in the filling is not impaired as would be the case if the cotton in the goods were subjected to a cotton-dye bath after being woven. The principal cloths in this classification are cotton, warp figured melroses, Florentines, glacés, brilliantines, lusters, alpacas, mohairs, rainproof cloths, and fancy waistings; and in these may be found the same great variety of weaves and patterns that is to be found in the piece-dyed goods already described.

Yarn Dyed. Yarn-dyed goods differ from those previously described in that they are made of yarns that are dyed before being woven, or yarns spun from dyed wool. Wool may be dyed in the raw state (fleece), slubbing, or yarn. Fleece dyeing is preferable for goods intended to stand friction and that, in spite of wear and tear, must preserve their color. It is preferred for dark-colored goods where much friction is to be encountered, but is seldom used for light colors, since these would be soiled during subsequent processes of manufacture. In this case every fiber is colored uniformly all over. The yarn from this wool and the cloth woven from it are dyed through and through and do not become grayish or whitish by wear and tear.

Slubbing dyeing is preferred to yarn dyeing, for the dyestuff penetrates the loosely twisted roving, and if unevenly dyed, the subsequent operations equalize most thoroughly the irregularities in color.

Yarn dyeing is especially applicable to checks, plaids, and suitings, and in their manufacture the drop-box loom (a loom with two or more shuttles) is used. Goods manufactured under this classification include cotton-warp checks and mixtures, all-wool homespuns, mixture coatings and suitings, storm skirtings, and rainproof cloths. These goods are made in a great variety of weaves, the effect in each being secured by the color and the weave.

Piece-dyed fabrics may be distinguished from yarn-dyed fabrics by unraveling threads of each kind. In the case of yarn-dyed fabrics the dyestuff has penetrated through the yarn, while in the case of piece-dyed fabrics the dyestuff has no chance to penetrate as completely as through the yarn-dyed fabric.

Shaded Goods. Many fabrics to-day are unevenly dyed, that is, unevenly shaded. The fabric has not the same shade from center to side and from end to end. The cause may be found in the steaming or in improper scouring.

Textile Printing. Printed fabrics such as print cloths can generally be distinguished by observing the back of the cloth. If the figure or pattern on the face of the cloth does not penetrate through to the back, but only shows the outline, the fabric has been printed. Fabrics are printed by coming into contact with rotating rollers on which the pattern is engraved.

Textile printing is one of the most important textile finishing operations. The direct method consists in printing a design in colors on either the cloth or the

warp. The cost of printing varies with the size and the number of colors involved. It is necessary to know the steps in textile printing in order to explain intelligently the selling points of different fabrics.

Artists' Designs. Printed designs are made by artists who are skilled in designing and have a knowledge of the harmony of colors — that is, colors that blend well. The design may be a simple geometrical figure, as a square or circle, or it may be a very elaborate design portraying some historical event, or a reproduction of some bird, animal, or scene. This design is made in the size and colors desired.

The artist's design is sent to the printing plant, where it is transferred to cross-section paper by an engraving artist. In doing this transferring, the design is magnified from three to twenty-five times by a camera device and is projected on a table. The object of magnifying is to bring out the fine details of the design as, for example, the structure of a flower.

The design is then transferred to sketch paper and carefully divided into squared sections. Every color or shade is drawn in fine lines, so that there will be as many sketches or parts like that design as there are colors. After enlarging each part of the design, each one is redrawn with an outline of soft black color, which will transfer readily to zinc plates, — the next step of the process. Each part in the enlarged sketch is colored like that in the original design, so that the several sketches form practically an exact copy of the original.

Next a large, smooth zinc plate, ruled in squares corresponding exactly in size with the squares of the several sketch papers, is treated with a coat of varnish, and when it is sufficiently dry the sketch is placed face downward on the plate and the back of the paper rubbed with a hand burnisher, which transfers the soft black outlines from the paper to the plate. An engraver then cuts out by hand the lines thus transferred to the zinc. This zinc plate is then placed in a machine called a pantograph.

After the cutting is finished, the zinc plates are scoured and the different parts colored to correspond with the colors in the original design. This enables the operator of the pantograph machine to distinguish the different shapes of each color to be traced on the copper roller.

TRACING THE DESIGN WITH THE PANTOGRAPH

A copper roller is placed in a receptacle at the top of this machine, where it comes into contact with diamond etching points on a carrier controlled by a needle in the hand of the operator, who traces the outlines of all forms of that color by causing the needle to follow the engraved line on the zinc plate, while the machine automatically reproduces an engraved line exactly similar on the roller above, reduced to the original size of the line in the design. This portion of the design is repeated all the way across the face of the roller.

The figures in the copper roller are filled in with slanting parallel lines far enough apart so that after the rollers are etched to the required depth they will furnish just enough color to

produce the desired shade. The grounding arrangement on the machine may be set to produce lines varying in spacing from ten to two hundred to an inch.

The printing usually requires a separate roller for each color or shade of a color. All rollers for a design must have exactly the same circumference.

The etching of the copper roller by the pantograph machine does not prepare the roller for printing, it merely cuts through

ETCHING THE DESIGN ON THE COPPER ROLLER

the varnish so that the copper can be attacked by the acid bath to which it is then subjected. Prior to the acid bath each roller is thoroughly inspected, and any imperfection in the varnish is painted out.

The etching table is provided with a stone water-trough immediately adjoining the acid bath in which the roller is immersed. The roller now on the shaft is first placed in the water-trough and revolved a few times to wash off any particles of dust. It is then lifted over into the acid trough, revolved by means of a crank, and watched closely as the acid eats away the copper where unprotected. From time to time the roller is taken out of the

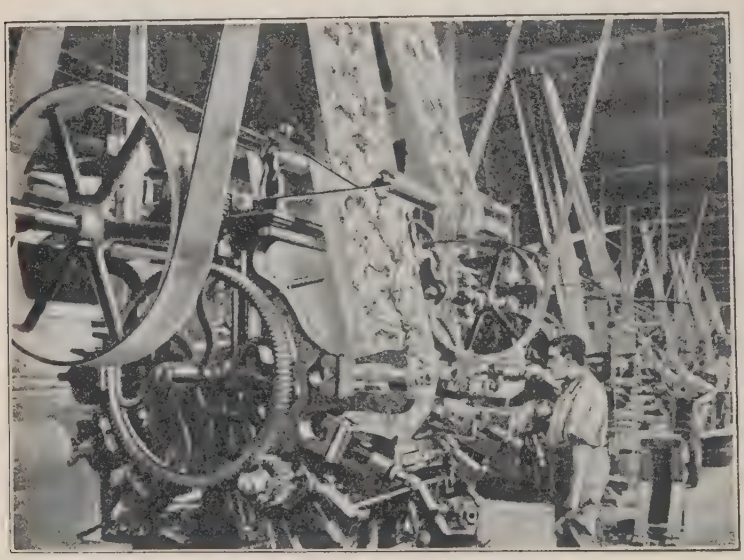
acid and placed in the water bath for examination, the operation being continued until the desired depth of etching is obtained. The varnish is then washed off with turpentine and the roller carefully inspected.

Usually some "pointing up" is necessary, and the work on the roller is then practically ended, except for polishing and facing to smooth the surface. The copper rollers, for such they are, are not discarded after having once been engraved, but when the design engraved on them is no longer desired for reproduction, the rollers are turned down on a lathe and polished by grinding with coarse and fine stones to remove all of the etched part of the design and all blemishes or tool marks. Then these copper rollers, slightly smaller in circumference, are ready for etching another design.

Direct or Roller Printing. The most primitive method of printing is by the use of stencils. It is the method used by the Japanese and Chinese. Next came block printing, which is still extensively used in Europe. The pattern is raised in felt on wooden blocks, the color taken up from pads, one block for each color. The results are good, but the work is very slow. Most textile goods are to-day machine printed. The design is engraved or etched on copper cylinders, one cylinder for each color; the color, thickened with gum, is supplied by rolls running against the cylinders, and the surplus is scraped off by a knife blade, leaving only that in the engraving which is taken up by the cloth. After printing, the cloth is steamed to set the colors, and then washed in order to remove the gum used to thicken the colors for printing.

Block Printing, as distinguished from machine work, is done by hand to-day in much the same manner as it was in Europe a century or more ago. The blocks

are built up of layers of wood, the grain crossed alternately. All of one color or shade in the design is printed with one engraved wood block, or, if the design is large, there may be more blocks for a color, each block printing a section of the design. Large spaces may be " felted "



PRINTING MACHINE

Showing the cloth passing over the etched rollers

to carry more color. Sometimes brass edgings are inserted to produce fine lines. The fabric is laid out on long, padded, heavily built tables. These are on solid foundations because of the pressure and pounding necessary in this work.

The block printer goes the entire length of the table applying one color, and follows this entire length with

each color in succession, the blocks being applied by hand first to the color pad, and then to the fabric. The pad is moved along close to the printer. Often each application of a color, especially where it covers the larger spaces, requires several poundings with a heavy mallet to insure satisfactory depth and smoothness of color. For larger spots of color it is often found necessary to make a second application in order to supply enough color.

Resist Method. Examine a piece of foulard and note that the design is white on a colored background. This type of cloth is printed by the *resist method*, as follows: The fabric is printed by rollers with a wax preparation, then dyed. The dye liquor penetrates every part of the cloth except where the wax is located. Then the colors are set and the wax is removed, leaving the white design on a colored background.

Discharge Method. Examine any fabric with a single colored background (e.g., dark blue) and a light blue design. This design is printed by the extract or *discharge* method. The cloth is first dyed and then printed with a discharge paste, which slowly remove part of the color, leaving the design a little lighter in shade.

Printing and Dyeing. Generally speaking, printed fabrics are known from dyed fabrics by the fact that the former have the design printed on the face of the cloth. This is called *direct printing*. The best dyed fabrics are obtained by dyeing in what is called a *jig*, and the whole fabric is saturated with color. Most of the cloths which you see in plain colors are dyed in the jig.

Some of the cheaper qualities of dyed fabrics are padded in a mangle, but there has been a very small quantity of these goods on the market for many years.

Printed fabrics may be made as fast as dyed fabrics; fastness of color depends upon the process by which the goods are converted. Within the past few years great headway has been made in dyeing with what are termed *vat* colors. Indanthrene is a vat color and many mills have used dyes of this class successfully in plain shades. This is what would be termed a *fast* color in every sense of the word. There are a number of dyestuff makers in Europe who put vat colors on the market, but they all call them by different names. Vat colors have been used with success in printing during the past year or two, especially on shirting fabrics, and these colors are fast to both light and washing. Most direct colors used for printing or dyeing are equally fast to light and washing, but of course they will not stand the test as well as the vat colors mentioned above.

The essential qualities of a good printed fabric are its ability to withstand exposure to light and washing. In printing, of course, a greater variety of desirable styles can be obtained than by dyeing, in fact there are certain popular lines of goods now on the market the designs of which cannot be obtained in any other way than by printing. At the same time, although the field in designing for dyed fabrics is limited, some very handsome effects can be obtained.

It will not be many years before a large proportion of the printed and dyed fabrics put on the market, both

foreign and domestic, will be in the vat colors, which, as stated above, are very fast. Even at present many mills use this class of colors entirely, especially the mills which manufacture woven fabrics.

Batik is a process of decorating textiles, originating from Java, which has become very fashionable in America during the last few years. Although it is employed principally on textiles, other materials, such as leather, straw, etc., can be treated the same way. The main principles of this process are as follows: The outlines of the ornamental design are traced over the cloth with a pencil, and such parts of the design as are to be saved (or excluded) from the first dye bath are covered with a thin layer of melted wax which soon dries and hardens. It must be observed that throughout the successive baths of dyes the coloring process always begins with the lightest or palest shade and proceeds with the darker ones. The melted wax (usually beeswax), is applied by means of a small cup with a pointed outlet and handle. In dipping the fabric into the first (lightest) dye the latter penetrates the cloth everywhere except where the wax covers certain areas. After the first bath the cloth is dried and the wax is removed by washing it in hot water and benzine, or kerosene. Wax is again applied to such parts of the design as are to be left free from the second dye bath. The process is thus repeated until the design is entirely developed through the various color applications.

Another method of decorating textiles is called knot tying dyeing. It is based upon the principle that the

dye liquor will penetrate a fabric in inverse proportion to the twist of the knot. That is, if the fabric is tied in a knot, the dye liquor will penetrate to a certain degree the whole knot, but will penetrate the outside more than the interior. This causes a gradation of color, forming designs.

Roller printing has certain limitations due to the size of the roller and the number of colors (not over 12 or 13). Block printing is more expensive, due to hand labor, and is not restricted to size and colors. A block print may be told from the roller print by the (*a*) size; (*b*) large number of colors; (*c*) unevenness of outline (due to hand work). In some cases better effects can be produced by block printing than roller printing. Batik decorations call for very fine lines that cannot be produced by either block or roller printing.

QUESTIONS

1. Why is color important in all kinds of textiles?
2. Explain how we "see" color.
3. Define the following: color; light; transparent; opaque; translucent; reflected light.
4. Upon what elements does the color of a textile depend?
5. (*a*) What is the spectrum?
   (*b*) What is the composition of white light?
6. (*a*) Why does a piece of silk appear brighter than a piece of cotton or wool?
   (*b*) Why is wool brighter than cotton of the same color?
7. What is meant by the term "color harmony"?
8. Why is color harmony the keynote of a good textile coloring or designing?
9. Where are the best harmonies of color found?

10. How can you illustrate the relation of complementary colors?

11. (*a*) State how we can add to the value of color.

(*b*) How can we subdue a color?

12. How may a flat color be made attractive?

13. (*a*) What is a dyestuff?

(*b*) How may dyestuffs be classified according to origin? Give an example of each kind.

14. (*a*) How may dyestuffs be classified according to their uses?

(*b*) Name the principal classes of dyestuffs according to use.

15. (*a*) State the difference between an acid and a basic dyestuff.

(*b*) State the difference between a direct and a mordant dyestuff.

16. What is dyeing? Printing?

17. Describe: piece dyeing; yarn dyeing; raw stock dyeing.

18. State the advantages and disadvantages of each.

19. Give a short description of the history of dyeing.

20. What care must be exercised in the matching of colors?

21. How do you distinguish between a printed and a dyed fabric?

22. Give a short history of textile printing.

23. Why is printing important in the finishing of cottons?

24. Give the steps in producing a printed fabric.

25. What should the artist bear in mind when working a design?

26. (*a*) Is the engraving artist the true artist?

(*b*) Is there any danger in the engraving artist modifying the design?

(*c*) Would he modify it in overcoming mechanical difficulties?

27. State the difference between a roller print and a block print.

28. Describe batik printing.

29. What is the value of knot tying dyeing?

CHAPTER IX

FINISHING WOOLENS AND WORSTEDS

Finishing. The fabric as it comes from the loom is in an imperfect condition for use. When worsted fabrics leave the loom they require but few and simple finishing operations, and in this respect differ much from woolen cloths, which require elaborate finishing operations. The finishing processes of woolen and worsted cloths are similar. The following description of processes and machines gives a clear idea of the necessary finishing processes for a standard woolen or worsted cloth; for particular styles of finish the processes must be varied in accordance with the particular requirements of the style of fabric in hand.

Perching. The fabric as it comes from the loom receives a perching and measuring inspection in the weave room before leaving for the finishing room. This examination is to detect quickly such imperfections as require prompt attention at the loom.

Burling. Every knot that has been tied in the threads during winding, dressing, beaming, and weaving must be looked for and felt for during burling, carefully drawn to the surface of the cloth, and then clipped off with the scissors, leaving the ends long enough so that no space without a thread will occur. Threads which

are found loose on the face or back of cloth, caused by the weaver having tied in a broken end, should be cut off and not pulled off. All places where threads are not woven in are marked so that the sewing-in girl (mender) can adjust such defects. The cloth is then subjected to perching again. It is examined for imperfections, and these are marked with chalk to call the attention of the menders to such places.

Mending. The object of darning or mending is to make all repairs in the structure of the cloth before the

SHOWING THE PROCESS OF WEAVING DAMAGES

process of fulling. The mender must have a good eye for colors necessary to produce various effects and for the interlacing of the threads. More exact work is required for threadbare fabrics that require little if any finishing than in dealing with a face finish fabric, where the nap is to be raised and will cover many imperfections so that they will never be noticed in the finished cloth.

Fulling. The object of fulling is to render woolen and worsted goods stronger and firmer in body. Fulling is similar to felting, the principal object of each being to condense the fibers, thereby increasing the firmness. Certain varieties of woolens are fulled nearly one-half their original width and length. The process

of fulling includes three steps: cleansing, scouring, and condensing the fibers of the cloth. The object of scouring is to get rid of oil used preparatory to spinning, and to remove from the cloth stains and the sizing used in dressing the warp. The cloth is first saturated with hot water and soap, and is then scoured and rubbed between the slow-revolving rollers of the machine from two to eighteen hours, according to the character of goods and the amount of shrinkage desired. The more prolonged the operation, the more the material shrinks. When sufficiently fulled, the length of cloth is scoured to free it from soap. This is done with water, warmed at first but gradually cooled, until at the end the cloth is worked in cold water. Next the cloth is stretched uniformly in all directions, so that it may dry evenly without wrinkles or curls. Sometimes the cloth is placed in a hot-air chamber to hasten the drying. The fulling or shrinking is effected by the application of moisture, heat, and pressure. Everyone is familiar with the fact that woolen blankets, flannels, and hosiery contract with frequent washings, gaining in thickness and solidity what they lose in elasticity. Such shrinkage is hastened when they are rubbed vigorously in hot water and then allowed to cool suddenly. This change is due to the physical properties of the wool fiber.

Such goods as beavers, kerseys, meltons, and fancy cassimeres are seldom fulled more than one sixth of their woven width, while worsted goods are shrunk but a small fraction of their woven width. The amount of fulling received is the distinguishing feature of many

varieties of cloth. In the treatment of broadcloth, doeskin, and all nap finished woolens, the fulling is carried to a point where the fibers become densely matted, obliterating all traces of the weave and giving the cloth the appearance of felt.

Crabbing. After the cloth has been dried in the hydro extractor, where it throws off superfluous moisture, it must be stretched full width for the future finishing processes, and "set" at this width.

Crabbing consists of two operations, first the loosening process, then the setting process. Goods are run on a cylinder, then passed over several rolls, and are kept tight so as to avoid wrinkles. The cylinders are immersed in hot water and the goods are allowed to rotate in this water for about twenty minutes, after which they are taken out for one or two hours. They are then returned to the machine for about twenty-five minutes and are subjected to boiling and also to additional pressure. The boiling water sets the fabric and the additional pressure gives the desired finish.

Tentering. The object of tentering [1] is to straighten and level the fabric. After the cloth leaves the tentering machine it has lost its natural moisture, and is not at all fitted, so far as fiber condition is concerned, for the napping. To bring it into a state fit for this operation it is passed through a trough containing a brush which gives it the desired moisture. It is then ready for napping. If tentering is performed carelessly, the filling threads show at an angle to the warp (often

[1] Tentering is carried on in the English mills

called by women " a little on the bias ") or lacking in smoothness.

Napping and Shearing. Most cloths at this stage of finishing are more or less unsightly on account of long and irregular fibers on the surface. A nap may be raised on the surface of a fabric for various reasons: in order to render the material warmer, softer, or more pleasant to the touch, as in the case of blankets and flannels intended to be worn next to the body; or for the purpose of increasing the durability of the fabric, as in the case of melton, kersey, broadcloth, and similar goods; or a nap may be raised with a view to removing all the fiber from the underlying structure in order to leave the pattern of the cloth well defined and free from hairiness. The covering of nap over the surface of the fabric tends to conceal many defects caused by imperfect yarns and faulty weaving. Coarse, inferior yarns at best produce an unsightly fabric, but when the cloth constructed of such threads is finished with a fine, delicate nap, the surface takes on a softer and richer appearance. Not only are the defects in the structure concealed, but the material appears to be more expensive than it really is.

The operation of napping, sometimes called *gigging* or *raising*, is performed by passing the cloth in a tightly stretched condition over a revolving cylinder covered with teasels or steel hooks. These thousands of little hooks scratch the entire surface of the cloth, opening up the short fibers and covering the whole with a nap. Since the fibers are of different lengths it is necessary

to brush the fabric vigorously and then pass it through the shearing machine in order to make an even and uniform length. The shearing machine acts on the principle of the lawn mower and either cuts the nap completely or leaves a pile surface. The cloth is cleaned by passing through a brushing machine.

Sometimes worsted fabrics are singed by passing through a gas flame. Small projecting fibers are burned. The cloth is washed to remove the odor of burned wool.

Sometimes finely cut-up wool waste is fulled into the under side of cloth in order to make it firmer. Sometimes it is used to cover up defects and make cheap fabrics of cotton and wool appear thick. Later this wool waste falls from the cloth and appears in the linings of coats and skirts.

Goods that are to be fulled are woven longer and wider to allow for the shrinking. Excess shrinking causes the cloth to be "bound."

Pressing Machine. The fabric now requires consolidating and lustering, or "smarting up" in appearance — practically pressing — before it is forwarded to the warehouse. This is done by passing the cloth over a pressing roll heated to a high temperature. Having obtained a satisfactory luster, it is necessary to fix this by winding the cloth on rollers and allowing dry steam to pass through the piece. This fixes a permanent luster and finish and prevents shrinkage.

The gloss may be increased greatly in mohair and alpaca fabrics by excessive pressure on the cylinders. Luster may be given to cheap broadcloth by the addi-

tion of gelatine. This adulteration may be determined by wetting the inspected sample and noting whether the luster appears after the spot has dried. If the luster does not appear, gelatine has been used. If the luster appears, it means a true lustered broadcloth.

Sponging. As soon as fabrics, especially woolens and worsteds, are received from the mill they are usually sent by the cutting-up trade to a local examining and sponging establishment, which examines the fabric for (*a*) width, (*b*) length, (*c*) evenness of cloth, (*d*) uneven yarn, and (*e*) missing threads, and shrinks the fabric for a few cents a yard.

Sometimes the designer in the mill makes a mistake in calculation and the fabric shrinks in the finishing operations more than is estimated. In that case, the cloth is stretched to the desired width in a tentering machine. If the cloth were made up into costumes and suits as it came from the mill, it would shrink on the first damp day and ruin the appearance of the garment. Sponging also prevents spotting, and is done as follows:

(1) Velour, duvetyn, wool plush, etc., are steamed, instead of sponged, by exposing the fabric to a vapor of steam.

(2) Wool and heavy cotton and linen are sponged by rolling the fabric between lengths of wet muslin and letting it remain there overnight. The fabric is then unrolled, dried, and pressed on the wrong side.

(3) Fine cottons, voiles, and Swisses are not sponged.

Wool Fabrics. Wool fabrics may be divided into three classes: woolens, unfinished worsteds, and worsteds.

A woolen fabric has a softer feel than a worsted, and an uneven or fuzzy surface. This fabric is composed of woolen yarn.

An unfinished worsted may be composed of (*a*) worsted warp and woolen filling, or (*b*) soft spun French worsted yarn. It has a softer feel than the worsted made from hard-spun English Bradford yarn.

Examine different types of worsted fabrics, and notice how many conform to the following requirements.

1. A good piece of worsted fabric should have a clear outline of the pattern, perfection of weave lines, and when the fabric is exposed to light should show a luster without polish.

2. The most essential point of worsted is that it should have a clean and even-looking face. By clean is meant well sheared. By even is meant that the individual ends and picks used should be *even* and not full of knots or of any foreign matter. Of course, there are some exceptions; for instance, an unfinished worsted which has more or less nap on the face could not be sheared absolutely clear, but nevertheless the face should be very evenly cropped.

Defects. — A serious defect would exist if the cloth was not well sheared or if it contained many uneven cords and picks, or if ends and picks were missing, or if it had coarse ends and slubs.

Examine different worsteds and notice any defects.

Worsteds. Speaking generally, worsteds may be divided into two classes, distinguishable according to the *luster* of their surface, or to the softness of their

feel. They are used for both ladies' and men's wear. Worsted coatings may also be classed as worsteds. The coatings are woven in both single and double cloths in fancy weave effects for piece dyes, and marketed in variety of finish, according to fashion.

Under this heading may be classified staple cloths, such as serges, clays, and fancy weave effects without any luster. They can be finished in three ways: clear, undressed, and cheviot, used for ladies' dress goods or men's wear, according to weight.

The finish of the cloth varies according to the fashion, but there is always a certain demand for clear and undressed worsteds for men's wear.

Examine a number of worsted fabrics and classify them.

Characteristics of a Good Piece of Woolen. A good wool fabric possesses the following characteristics:

1. Stands hard wear on account of high tensile strength.
2. Warm — poor conductor of heat.
3. Holds its shape, due to its elasticity. It is more elastic than cotton.
4. Does not feel cold when damp, due to hygroscopic qualities.
5. Fast to sunlight; great attraction for dyestuffs.
6. Does not soil as easily as cotton, due to smooth surface of scales.
7. Tends to shrink when washed with friction, etc., due to felting properties.
8. Adapted to purposes where warmth is required and frequent washing unnecessary.

9. Soft, thin woolens will not shrink.

10. Worsted fabrics will wear shiny, owing to the smoothness of the surface, due to the smooth yarn.

11. Woolen fabrics will not shine, but the nap wears off or is pressed down with wear due to friction. A thick nap will not show wear as quickly as a thin nap.

12. Woolen fabrics spot quicker than worsteds, and it is more difficult to remove the spot, due to the nap.

13. Woolens will not tailor as well as worsteds, as their softness does not aid in holding the shape.

14. Wool is subject to moths. This may be remedied by keeping moth-balls near the folds in the fabric.

QUESTIONS

1. (*a*) Is it possible to use woolen and worsted fabrics as soon as they have been woven?
   (*b*) If not, what changes must be made in them?
2. Describe perching; burling; mending.
3. (*a*) What is "fulling" in the finishing?
   (*b*) Describe the operation in detail.
4. Explain the difference between crabbing and tentering.
5. (*a*) Tell what you know about napping.
   (*b*) What is the difference between a napped fabric and a pile fabric?
6. What is the object of shearing? Of singeing?
7. Is the cloth ready to be cut into suits on leaving the mill? If not, explain why?
8. Explain the pressing operation.
9. What is a local finishing and sponging plant?
10. What are the common defects that are noted in a piece of woolen cloth?
11. Describe the process of textile sewing or mending.
12. Give the characteristics of a good piece of wool.
13. State the characteristics of a woolen; unfinished worsted; straight worsted.

CHAPTER X

NAMING A FABRIC

There are many methods of describing a fabric; for example, the mill manufacturer is inclined to describe a cloth according to its *structure,* because he builds the cloth according to specifications from the styler and designer. Cloth according to structure may be classed as (*a*) *woven* — serge; (*b*) *knitted* — tricolette; (*c*) *plaited* — lace; (*d*) *felted* — piece of felting.

If the fabric is woven, the exact method of interlacing may be given as plain weave, twills and sateens of different harnesses, Jacquard, lappet, gauze or leno, double cloth, pile, etc. Each weave is used for a definite purpose. The plain weave is the strongest weave to resist tensile strength, the sateen weave to resist friction.

The consumer, on the other hand, is very likely to think of a fabric as he *sees* or *feels* it, according to *composition* and *finish.* The composition, color, and feel of a fabric may be expressed in such terms as describe crêpe de Chine, which is soft, very thin, sheer, translucent, and is valuable for lingerie.

Many other people, such as tailors, are very likely to describe a fabric in terms of its *use.* A serge is used to make *suits,* therefore it is called *suiting.* A serge for

ladies' suiting is made of softer yarn than a serge for men's suiting.

Texture. A word used frequently in describing cloth is *texture*. It refers to the feel or finish and weave of the fabric. In other words, it refers to the sensation we experience when we close our eyes and feel of a fabric. A fabric may be fuzzy, napped, stiff, fluffy, soft, etc. The texture is governed by the composition and twist of the yarn, weave, and finish. If we desire a fuzzy surface, the cloth is made of loosely spun (in part or whole) yarn and is loosely woven. If a very fuzzy surface is desired, a pile weave is used. Soft, lightweight fabrics are used for draping purposes, so that when the fabric is made into garments it will fall in straight folds and cling to the body. The softness is given to the fabric by fineness of yarn and very little, if any, sizing.

Stiff fabrics that stand out from the body are composed of hand-twisted ply yarns, closely woven and, perhaps, with the additional use of sizing. Hair and very stiff fibers give added stiffness to fabrics.

Styles. Since styles and designs are constantly changing it is necessary for the mills to meet this demand by producing new styles. Some of the patterns which are at the present time considered in the best style would have appeared much out of date two or three years ago, while perhaps a few years hence, the patterns which are now almost obsolete will, with some changes, become the most popular sellers of the season. As the mill officials or designers are not out among the

trade, they are not in a position to judge what lines or patterns will most likely appeal to the market. This information is obtained by the styler of the selling house. The styler receives the latest foreign samples and fashion papers from abroad, and often goes or sends his representative to Europe to ascertain what goods, designs, and colors are popular there. The selling agent or styler then supplies the designing department of the mill with all the samples, information, and suggestions necessary for getting out its samples.

Construction of Cloth. In reproducing a sample of cloth in the mill it is necessary that the construction of the fabric be first known, that is, there must be ascertained the width, warp ends, and picks per inch, the number or size of the yarn used for the warp, the number that is used for the filling, and the number of ounces per yard or yards per pound. Then the interlacings of the threads in the sample must be picked out in order to get the design or weave on the design paper, from which the data are obtained for regulating the movement of the harness or heddles. Design paper is paper ruled by lines into a number of squares. An imitation of the cloth can be produced on this paper by showing the interlacings of the warp and filling. This is done by filling in certain squares with paint, or pencil marks, while the others are left empty. In practical work it is the general custom to make a cross with a pencil to indicate the squares that are to be filled in, thus showing that the warp thread is over the filling thread at this point. When a square is left blank it

shows that the warp thread is under the filling at this point. When a warp thread is up on a certain pick, the harness which controls this thread must be raised on this pick.

Staples and Fancies. Fabrics are named by manufacturers or merchants who introduce them to the market. If the fabrics are durable and popular, they are made from year to year and are called *staples*. The tendency is to place on the markets *substitutes* which are cheaper than the staples. For example, a fabric composed of cotton and wool may be placed on the market and called *albatross*.

A number of firms have on the market cotton fabrics with printed checks and insist on calling them ginghams. A true gingham is a yarn-dyed fabric with checks. Of course, these printed checks are novelty ginghams of a cheaper grade, and not true ginghams in terms of the original fabric. A historical knowledge of the fabric will tell immediately the true description of staple fabrics.

It is important to know something about the history of fabrics, because the true weave of a fabric belongs to the original fabric, and a change in the weave makes fabrics novelties instead of staples, and of cheaper grade. In fact, the historical development of textiles shows that there is a tendency to offer substitutes for popular fabrics. The substitutes are usually made to resemble the original fabric, but differ in composition, finish, etc. The manufacturers of the substitutes usually insist on considering these fabrics as a true type fabric.

Dress goods fall naturally into two distinct classes when regarded from the standpoint of fashion — *staples* and *fancies*. Staples are those fabrics which are made of the same construction year in and year out. They vary only in coloring to meet the changes of fashion.

The staples may be illustrated by the following fabrics:

Brilliantines	Cheviots	Nun's Veiling
Sicilians	Panamas	Cashmeres
Mohairs	Batistes	Shepherd Checks
Imperial Serges	Taffetas	Serges
Storm Serges	Voiles	Broadcloths

Fancies are fabrics produced to meet the demands of style. They may remain in favor a year or two. The fancies are fabrics differing from staples in weave, color, and composition, and are produced through: (1) Variation of weave; (2) variation of color; (3) variation of color and weave.

Examples: Brocades, cuspettes, meliores, hopsacking, etc.

Coloring includes: Stripes, checks, plaids, malenges, mixtures.

Every large selling-house places on the market every season the usual staples, and a larger or smaller number of novelties or fancies. The staple fabrics will be sold because there is always a demand for them. The selling of the novelties is a problem. It all depends on how successful the styler has been in determining the popular taste or style. If they do not sell as soon

as they are placed on the market, it is extremely doubtful if they will be in any considerable demand.

Theories of Coloring in Textile Design. The three primary elements of textile design are weave, combination of form, and blend of colors. They enter either separately or in connection with each other into every species of loom effect. Weave relates specifically to the build or structure of the cloth and is an indispensable factor in any type of fabric. Schemes of weave will produce in one operation an even and firm cloth decorated with a type of pattern that usually consists of minute parts, but which is pronounced and decided in combination. Combination of forms is a surface decoration obtained by uniting straight and curved lines. Color brightens and improves the qualities of the design. In fact, the discarding of color shades would diminish the elegance of the design and impoverish its appearance and would practically destroy the woolen industry. Whether the pattern be stripe, check, figure, or intermingled effect, it obtains its outline and detail from the methods of coloring adopted. In worsteds there is a larger diversity of weave design than in woolens; but still colors are very extensively used to develop effects due to weave and form and also to impart a cheerful and lustrous appearance to cloth.

Patterns in dress fabrics, shirtings, and other articles made entirely of cotton are frequently mere combinations of fancy shades, while fabrics composed of silk and jute materials, including silk ties, handkerchiefs, etc. — in fact, the cloths in which fancy shades are

used — show that coloring and its combinations in all woven products embellished with design are elements which give tone and character to the styles. Though the cloth may be soft to the touch, substantially made, of uniform structure, and skilfully finished, yet a lack of brightness and elegance in coloring so powerfully detracts from the appearance of the pattern that these qualities alone are not sufficient.

The various methods of employing fancy shades in patterns obtained in the loom may be briefly summarized:

I. In mixture cloths, for suitings, coatings, etc.

a. By combining or blending various colors of materials.

b. By combining several classes of twist threads.

II. In plain, twilled, mat, and fancy weave designs for trouserings, coatings, suitings, jackets, dresses, costumes, flannels, shirtings, etc.

a. By introducing colors into the warp, forming stripes.

b. By introducing colors into the filling, producing spotted patterns.

c. By introducing colors into both warp and filling, giving checks, broken styles, etc.

III. In figured designs for dresses, vestings, etc.

a. By using one or several series of extra warp yarn.

b. By using one or several series of extra filling.

QUESTIONS

1. State some of the methods used in describing a cloth.
2. What is the difference between structure and finish of a fabric?
3. Why does the designer lay great stress on the structure of a fabric?
4. Explain the difference between a consumer and a customer, in describing a fabric.
5. How are fabrics designed?
6. What is the difference between a staple and a novelty? Name a staple. Name a novelty.
7. (*a*) How is a fancy fabric made?
   (*b*) Is there any relation between a fancy and a staple?
   (*c*) Give an example of each.
8. Why is it important to know the historical development of a fabric?
9. Why is it necessary to determine the use of a fabric in order to describe it?
10. Explain how fabric styles are made.
11. What are the duties of a styler?
12. Why is it necessary to place novelty fabrics on the market each season.
13. What determines the sale of a novelty?

CHAPTER XI

WOOLEN AND WORSTED FABRICS

The following descriptions of woolen and worsted goods are given in order to bring before the student a history of the fabrics, their uses, how they are made, and the selling points.[1]

These represent the staple fabrics, and if one knows how to identify and describe them, he will experience no difficulty in describing the novelties which are based upon the staple with modifications in the composition or weave.

Albatross. A dress fabric of either wool, cotton, or worsted warp and worsted filling, of open texture and fancy weave. It is used for kimonos and linings.

Albert Cloth. A woolen fabric used for overcoating. It is woven with a double-cloth weave for weight and warmth.

Alpaca. A thin fabric of close texture made from the fibers of an animal of the llama species; mixed with silk or with cotton. It is usually woven with cotton warp and mohair filling. Imitations of all cotton are manufactured and sold under this name.

[1] Suggestions to Teachers. In connection with the study of fabrics the author has found it advisable to have the students insert in a blank book a sample of the fabric they are studying. In this way the student can examine both the filling (weft) and warp threads.

Corded Alpaca. Corded weave, lengthwise of the piece, cotton warp alpaca filling; one of the first products of the American loom.

Angora. (Mohair.) The fiber of this goat is commercially known as mohair. The skins are largely used in the making of children's muffs, for the scalps of dolls, and for trimming coats, capes, and ladies' sweaters. Carriage robes also claim a good share of the skins; the hair, being nearly one foot in length, makes them beautiful and serviceable. The fiber enters largely into that class of goods known as Astrakhans, crepons, plushes, brilliantines, zibelines, fine Cashmeres, and many other fabrics usually sold as all wool or worsted, according to the mode of preparing the stock before spinning into yarn. It is found in the finest of silk and worsted fabrics for ladies' wear, also in linings, mittens, and fine cloaking and overcoating. It is noted especially for its water repelling qualities, its beauty, and high luster; and not so much for its warmth-retaining properties, for which wool stands unequalled.

Astrakhan. Originally a fabric manufactured from Astrakhan fiber which has a curly, wavy surface. To-day the name is applied to a curly-faced cloth resembling Astrakhan fleece, used for fur coats and trimmings. Most of the Astrakhan fabrics are woolen fabrics with a curly pile. The best grades are woven, while cheaper grades are knitted in structure and then napped. In order to give luster to the fabric the pile effect is made of mohair warp. The curl is given to the mohair by

steaming it on spindles under tension. Mohair retains its shape when pressed under heat. When the tension is removed the mohair curls. The ground may be of either cotton or wool. This fabric is quite expensive, but cheaper than the real fur. It is unbecoming to stout persons, although it is stylish for elderly women, and has been used for both young and old.

Bandanna. From the Indian *bandanna*, to bind or tie. In dyeing, the cloth is tied in knots when dipped, and thus has a clouded effect.

Barathea. This name is applied to a worsted that wears well, resembling melrose, and is used for dresses. Since it wears well it will not shine like most worsteds because it has not a perfectly smooth surface but a "grumbled" appearance, due to a wavy or ribbed surface.

Batiste (wool). A soft, light weight worsted fabric resembling cotton batiste, used for house dresses and children's dresses. Since it is made of worsted it has a smooth surface and a wiry feel. In order to make it light in weight it is woven as a plain weave.

Beaver. A heavy cloth manufactured of fine wool, with a finish on the surface resembling the fur of the animal of that name.

Fur Beaver. Similar in many respects to beaver, but having on its surface a long, very dense nap, in imitation of the best fur. Used for overcoats, cloaks, and capes. The fabric may be made of a plain weave with one set of hard-twisted warp yarns and two sets of filling yarns or as a complete double cloth. In order

to give a soft face it is customary to use a fine wool having good felting properties. The finish consists of the following operations: felting, napping, cutting, steaming, dyeing, (beaver, tan), brushing, and pressing. Constant wear will " wear off " the pile and make it look shabby.

Blanket. A term applied to any thick wool, cotton and wool, or cotton fabric with a short nap on each side, used for bed clothing, bathrobes, etc. The cotton blankets do not wear well as friction and washing destroy the nap, which is composed of short cotton fibers, while the nap in the wool has long fibers.

Bolivia Cloth. This name is applied to a class of wool pile fabrics under different trade names, used for coats, wraps, and capes. There are both expensive and cheap fabrics. The expensive fabrics are stylish and have a long nap with a rich, silky appearance. Since it is a pile fabric it is light, but catches the dirt easily, and the pile presses down, giving a shabby appearance. The difference in quality is due to the construction, adulteration, and character of the wool used.

Bedford Cord. A fine woolen fabric, with fine recesses running with the piece; extensively used for ladies' dress goods. The recesses may also be made with fine cotton yarn hidden in the wool filling. It is usually made of single or two-ply hard-twisted warp yarn. It is finished by fulling, brushing, shearing, and pressing. Since it is a woolen, it is expensive, lacks the beauty of a nap surface, and does not tailor as well as a worsted.

Beige. Cloth of undyed or natural wool. The name is the French word for "natural."

Bindings. A species of narrow fabric of silk, worsted or cotton, for binding the edges of garments, the bottom of dress skirts, etc.

Bombazine. A twilled fabric of which the warp is silk and the filling is worsted.

Bottany. A term applied to worsted yarns made from bottany wool. It is considered the finest of all worsted yarns, and is used for fine fabrics of close texture.

Boucle. Curled hair or wool woven in any cloth in such a way as to show the curl makes boucle. The word is French for "curl." It is used for skirtings and coats. Being woven of novelty yarn, it tends to wear shabby.

Broadcloth. Broadcloth is a soft, closely woven material with a satin finish, used for coats, suits, and skirts. The best qualities are called satin broadcloth.

The origin of broadcloth dates back to early times, the first historical mention of it being made in 1641. In America, among the first products manufactured by the colonial woolen mills were black and colored broadcloths, and these (with satinets) formed the distinctive character of American woolen fabrics at that time. They were honestly made of pure, fine-fibered Saxony wool, and sold as high as $6.50 per yard.

The warp and filling are made of carded wool so that the web (cloth) will shrink or full evenly. The stock is generally dyed in the raw state when used for men's wear. When taken from the loom it does not have the

smooth, lustrous appearance which is its distinctive feature. It is rough and dull colored, with the threads showing plainly. To improve its appearance it is first subjected to the action of the fulling mill, with the result that the fibers of the warp and weft become entangled. Then the cloth is slightly napped and sheared down close, in order to produce a smooth, even surface. Next it is successively wetted, steamed, calendered, and hot pressed for the purpose of bringing out the luster. It is commonly twill woven, but is sometimes plain. It must have a bright, beaver finish, and be close and felty in weave.

Sometimes a worsted warp and woolen filling are used. As the fabric is always fulled, it is possible to make an inferior cloth of good appearance by adding gelatine for a luster. The best broadcloths have a natural luster, due to the lustered wools used. The inferior grades may be determined by wetting the fabric with the finger. If the luster does not return, gelatine has been used in finishing. The broadcloth used for women's clothing is of a lighter weight and is generally piece dyed.

Chiffon broadcloth is used for dresses and light-weight suitings and has a very "shiny" surface. *Doeskin* fabrics are usually broadcloth fabrics heavily fulled, with a short nap that is pressed.

The price depends on the quality of wool used, uniformity of nap, and perfection of finish. Since broadcloth has a nap, it does not wear shiny as a worsted. Since it is softer than a worsted, it drapes well (falls

in graceful folds) but wrinkles easily and " catches the dirt." As far as wearing qualities are concerned it is an expensive fabric.

Bunting. A plain, even thread weave of mohair, wool, or worsted, used mostly for making flags. The name is from German, *bunt*, meaning variegated or gay colored.

Caniche. A name given to a curled wool fabric showing the effect of the coat of the caniche, a French dog.

Camels' Hair Cloth. A new fabric, made of camels' hair and wool, used for coats, scarfs, etc. Camels' hair is warmer, softer, and lighter than wool. Most of the so-called camels' hair and camels' wool fabrics are made of wool. It is usually dyed in a tan color which soils easily.

Cashmere. Originally a cloth made from the hair of the Cashmere goats, which are grown for their wool in the valley of Cashmere in the Himalaya Mountains. The yarn was hard spun, hence coarse and uneven. The fabric was woven with a twill weave, which was uneven and irregular because of the unevenness of the yarn. To-day the term is used for a wool twill-woven fabric, finished soft, and used for dresses, kimonos, etc. Since it is a soft woolen fabric, it drapes well but tailors poorly, and can be laundered. It does not wear well, as friction soon destroys the fabric.

All Wool Cashmere. As no material by this name exists, there can be no definition. When the term is used in defining a fabric, it is a delusion and a snare.

Cashmere Double. A cloth having Cashmere twill on one side or face and poplin cord on the reverse.

Cassimere. The name is a variation of Cashmere. Originally cassimere was made of Cashmere wool; now usually a twill in woolen fabric made in different weights, qualities, and designs, used for men's shirtings. It is a closely woven fabric, with a clear finish that does not cover up the weave. It is finished by napping, shearing, brushing, wetting, and pressing.

Castor. Same as beaver, of a light weight.

Challis. (Also spelled *challie.*) A name given to a superior dress fabric of silk and wool first manufactured at Norwich, England, in 1832. In texture the original material was soft, thin, fine, and finished without gloss. When first introduced it ranked among the best and most elegant silk and wool textures manufactured. It was composed of fine materials, and instead of giving it a glossy surface, such as is usually produced from silk and fine wool, the object was to make it without luster. The name is now applied to an extremely light-weight summer dress fabric, composed of either cotton or wool, or a mixture of these. It is used for women's and children's dresses. In structure it is plain woven, the ornamental patterns being produced by printing and dyeing. It is not sized. All wool challis does not differ essentially from the old-fashioned muslin delaine. Most challis patterns are copied from the French silks, and this accounts in part for their tasteful designs and artistic effects. French challis is a material similar to the above, though usually characterized by

a more glossy finish, and is softer than the domestic. This fabric is light and soft for tailoring. Since it is woolen, it has all the properties of a woolen fabric, but not a worsted fabric. It is warm and does not shine, but does not show a smart-cut outline as is the case with a worsted.

Cheviot. A descriptive term of somewhat loose application, being used indiscriminately of late years to denote almost any sort of stout woolen cloth finished with a rough and shaggy surface, used for suitings. Originally the fabric known as cheviot was woven in England, from the strong, coarse wool of the Cheviot sheep, whence the name.

It is at present a worsted or woolen fabric made of curly cheviot wool or " pulled wool," slightly felted, with a short even nap on the surface and a supple feel. Worsted cheviots, in plain colorings or of fancy effects, are manufactured from combed yarn. Woolen cheviots are made from carded yarn. The greater portion of this class of goods in carded yarns contains little or no new wool in its make-up. Shoddy, mungo, and a liberal mixture of cotton to hold it together, blended in the many colorings, help to cover the deception. The material is plain or twill woven, and has many of the qualities of serge.

The distinguishing feature of cheviot, whatever the grade of cloth, is the finish, of which there are two kinds. One is known as the " rough " finish, and the other as the " close " finish. Real cheviot is a rough-finished fabric, composed of a strong, coarse wool and

fulled to a considerable degree. The process of finishing cheviot is simple, and practically the same methods are followed for both the " rough " and the " close " styles. On leaving the loom the cloth is first washed in soap and water to remove any dirt or other foreign matter it may contain. It is then fulled. Next it is napped. This operation is continued until a nap more or less dense is raised over the entire surface.

From the gig the cloth is taken to the shearing machine, which cuts the long, irregular nap down to a uniform level. Sometimes the style of finish called for is that approaching a threadbare cassimere, and in this case great care is necessary to prevent the blades from cutting the yarn. In the rough finish the nap, although sparingly raised, is comparatively long. Having been napped and sheared, the cloth is pressed and carefully examined for defects, then brushed, pressed, and highly steamed. When measured, rolled, and steamed, it is ready for market, and is used mostly for ladies' and gentlemen's suitings. The patterns and designs are light stripes and checks of small dimensions.

Cheviot is a name given to many materials used for suitings which show the weave but are softened by fulling and napping. The better qualities are quite durable, the cheaper ones wear shabby, due to the nap wearing off.

Chinchilla. Originally a heavy coating with a rough, wavy face. The name is Spanish, for a fur-bearing animal of the mink family. Chinchilla is a soft, heavy woolen fabric, with a curled pile, used for overcoatings.

It is loosely woven as a double or three-ply cloth. It may be felted or napped, or, by using a special machine, given a short curly nap resembling Astrakhan. Sometimes the long pile is formed by floats of filling threads. In this case it is not felted. The short curly pile is formed by two cylinders, one of which is stationary while the upper moves with rotary motions, forming the pile into little curly nobs. They are seldom pressed. They are usually sold in solid color with fancy (colored) backs. The nap catches the dirt and is therefore difficult to keep clean. Various grades are on the market, due to difference in composition and care in finishing.

Chuddar. Applied to billiard cloth; relates to color. Chuddar is the Hindoo name of a bright green cloth.

Clays. Clear finish worsted fabrics, woven in six-harness twill (three up and three down), and given a soft finish and full handle, every thread showing well. The yarns are usually given a few twists less than similar yarns employed for other fabrics. The finer grades are often not singed — only the coarse ones. The fabric is dyed in the piece. The warp ends and the filling are usually of the same size except when, in the lower grades, five-harness warp face twill is used with three up and two down; in this instance the filling is of lower count than the warp. Clay worsted was one of the most popular standard fabrics for men's wear more than 30 or 40 years ago, especially in heavy weights, while at present the weight is seldom more than 18 or 20 ounces. The fabric is said to have been named after an English manufacturer who invented it toward

the middle of the nineteenth century and made the best grades.

Corduroy. A heavy corded wool or cotton material used for servants' livery. The name is from the French *corde du roi* — king's cords.

Corkscrew. A worsted dress fabric, usually for men's wear, woven with a very low angle diagonal twill (running more weftwise), sometimes also forming a flat herringbone effect. The name is from the twists which at close inspection have a fancied resemblance to the threads of the corkscrew. From 20 to 30 years ago it was one of the most popular fabrics.

It is made in a variety of weaves, the corkscrew effect sometimes covering the entire face; or it may be combined with other weaves, forming more or less prominent stripes. In every instance it is a warp face fabric, made in the best qualities with a French (dry) spun worsted warp, the filling being of lower grade stock of worsted, or of woolen, and sometimes even of cotton; the weave is a derivative of the satin twill. The fabric is also made with backing yarn for heavier weights.

Côte Cheval. In France a corded cloth for riding costumes, such as Bedford cord, is called côte cheval, the application being through *cheval*, horse; *côte*, ribbed or lined.

Coupure. *Coupure* is French for "cut through." Coupure or cut Cashmere is a Cashmere weave showing lines cut through the twills lengthwise of the piece.

Covert. A medium heavy twilled cloth in *natural* undyed shades, originally used in England for men's overcoats worn while riding to covert in fox hunting. The warp is formed of two yarns of different colors twisted together, while the filling is made of two-ply or single yarn of one color, closely sheared, brushed, sprayed, and pressed. It is used for coats and dresses — chiefly sport costumes. Since it is used for outdoor wear it must not show dust or dirt and must not wrinkle. Therefore it must be a tightly twisted worsted fabric, closely woven so that it will be wiry and not lose its shape. It must have a color that will not show dust; tan or olive green with little spots, white in the cotton yarn, is used. It may be waterproofed and used for raincoats.

Crêpe. The name is applied to a class of crinkled fabrics made of woolen, worsted, silk, or cotton. It is a soft draping fabric, produced either by a fancy twill weave or by highly twisted yarns of left and right hand twists, arranged in both warp and filling. The additional twist in the yarn causes the fabric to crumple up when unwound from the bobbin in weaving. The fabric is washed, dyed, brushed, sheared, and pressed. It is used for dress fabrics.

Delaine. From the French " of wool "; applies to the most primitive weave of plain wool yarn. Thirty years ago delaine was the staple dress goods stock. It was made in solid colors.

Diagonal. A heavy, usually uneven-sided twill, running diagonally. Dress fabrics made of worsted

or woolen and woven with similar twill are also called diagonals.

Diagonal Cheviot. Same as cheviot, only in the weaving the pattern is marked by zigzag lines or stripes.

Doeskin. Of the broadcloth type, made with shiny napped face, soft finish, as the pelt of a doe. It must be heavily fulled, with a nap that has been pressed to give a shiny surface.

Drap d'Été. A heavy Cashmere or double warp merino, with the back teasled or scratched, used mostly for clergymen's clothing and in lighter weights for women's dresses. The name is French for "cloth of summer."

Duvetyn. A very stylish soft wool fabric with a twill weave and a fine silky nap. The selling points of this fabric are: soft, more lustrous, and richer looking than velour, and drapes well. On the other hand, it does not wear well, as the nap soon wears off, making it look shabby. It spots and catches dirt, due to the nap, which often flattens. It is made of a good long-staple wool two-ply yarn for the warp, and a fine soft merino wool mixed with waste silk for the filling. It is dyed in the raw stock and finished by fulling, napped in the wet condition, cut to an even nap, steamed, tentered, dried, and brushed. The difference in quality is due entirely to the composition, which may be cotton, wool, or silk.

Empress Cloth. Similar to poplin; made of hard twisted worsted filling and cotton warp. It was made popular in the early seventies of the last century by

the Empress Eugenie of France. Empress cloth was once a staple in all well-regulated dress goods lines.

Épingline. A fine corded fabric of wool or silk, showing the cords woven close together and appearing as if lined with a pin point. This application is from *épingle*, French for pin. It is used for suits and dresses. It looks like poplin, but differs in the size of the cords, which are of different sizes alternating, and on account of this difference in structure is not as durable as poplin.

Eponge. A soft, spongy fabric composed of novelty yarns of coarse sizes. Used for dresses, trimming, and drapery. The novelty yarn is usually placed either in the warp or the filling or in both. The fabric may be raw stock or piece dyed and woven as a plain weave. No finishing is necessary except a slight shearing.

Etamine. French name for bolting or sifting cloth, made of silk, for sifting flour; applied to mesh or net weaves in America.

Felt. Fabric made by rolling or pressing a pulpy mass or mixture of wool into a flat mat. The name is from the process. To felt is to mix and press into shape. While some felts are made by pressing the carded slivers, others are made by weaving or knitting, followed by heavy napping. This nap is then pressed into the body of the cloth. Felt is used for felt hats. Felts are often classified according to their finish, as soft, hard, compact, rough, and fuzzy.

Flannel. Wales appears to have been the original home of flannel, and history informs us that this was the only textile produced in that country for hundreds

of years. To-day a flannel may be a fabric constructed either of cotton or wool, or of an intermixture of these fibers, and is a coarse-threaded, loosely woven, light-weight cloth, more or less spongy and elastic, with an unfinished, lusterless, nappy surface. It may be plain or twill woven, made of plain or worsted yarn. Ladies' cloth opera flannel is made of woolen yarn and looks like broadcloth.

Generally speaking, all grades of plain colored flannel are piece dyed, the soft open texture of the goods permitting the fibers to absorb the dye as readily in the web as in the yarn. Flannels are subjected to several finishing operations, such as fulling, teaseling, pressing, and stretching. Flannels do not require a great deal of fulling. All that is necessary is enough to give a degree of stability and body to the goods.

There are many kinds of flannels.

Baby Flannel. A very light-weight, tightly woven fabric of fine, soft wool, of smooth finish, bleached pure white for wear and cleanliness. It is used for babies' shirts, petticoats, etc.

Dress Flannel. An all wool fabric used chiefly for women's winter dresses; also called flannel suiting. It has a diversity of qualities, colors, and styles of finish. It is commonly put up in double-fold, width from twenty-six to fifty inches.

French Flannel. A fine, soft, twill woven variety dyed in solid shades, and also printed with patterns after the manner of calico; used for morning gowns, dressing sacques, waists, etc.

Navy Twilled Flannel. A heavy all wool variety, commonly dyed indigo blue, used for overshirts for out-door laborers, firemen, sailors, and miners.

Shaker Flannel. A variety of white flannel finished with considerable nap, composed of cotton warp and woolen weft.

Silk-Warp Flannel. A high grade, pure variety of flannel woven with a silk warp and a fine woolen weft. It is a very soft, light-weight, loosely woven flannel and runs only in narrow widths — twenty-seven inches. If the finishing process is carried beyond fulling the texture is rendered hard and firm, the cloth thus losing its softness and elasticity. In the teaseling process it is necessary for the nap to be raised only slightly, and this is commonly done in the direction of the grain or twist of the warp. The perfection of a flannel finish lies not in the smooth appearance of the cloth, but in its full, rich softness. Sometimes the nap is sheared, but more often it is pressed down flat upon the face of the cloth. After a thorough drying and careful examination for defects, the goods are rolled on boards and are ready for market. It is used for infants' wear and shawls, for undergarments, bed coverings, and also to some extent for outer garments in weights and styles adapted for that purpose.

Florentine. A heavy twilled mohair fabric for men's wear which is sold largely to Italy and Spain. The name is from Florence, Italy.

Foulé. A twilled, unsheared cloth; that is, the face appears to be unsinged, and shows the woolly roughness

in a slight degree. The cloth when woven in the gray is fulled or shrunken in width by soaking in soapsuds and passing it while wet through holes of different sizes in a steel plate. The name is from *fouler*, French, to full or shrink.

Frieze. Frieze is a coarse, heavy cloth with a curly surface and was made at first of lamb's wool. It is now made from coarse grades of wool. It is thick and heavily napped, and is used in the manufacture of warm outer garments, particularly for men's wear, and is expected to be durable. It was named after the people of Friesland in Holland in the thirteenth century, and is famous to-day as an Irish fabric. Irish frieze has extraordinary durability, and the fibers are the longest and strongest made. The weave is plain, small twill, or herringbone. When not of a solid color it is usually a mixture, the colors being mixed in the raw state. The wool is dyed in the raw state in mass, then doubled after spinning. The qualities vary according to the composition. Wool waste and shoddy are extensively used.

Gaberdine. A strong worsted fabric, made of a twill weave showing fine diagonal cords, used for suits, dresses, and raincoats. The qualities vary according to the quality of the yarn and the finish. The composition may be either wool, silk, or cotton. The better grades are composed of hard-spun two-ply warp yarn and a coarser two-ply filling, while the cheaper grades have a single filling. When the fabric is used for raincoats it must be waterproofed. It is piece dyed. The fabric looks like Poiret twill and serge. In ga-

berdine the diagonal or cord effect is coarser than Poiret twill. Since gaberdine is a worsted fabric with a tightly twisted yarn, it tailors well, gives a smart appearance, but will shine with wear.

Gloria. A weave of silk and wool, and silk and cotton; first made for umbrella covering. The name means bright. Since it must be serviceable, it is a closely woven fabric with twill weave.

Granada. A popular weave of mohair, made in coating weight for Spanish trade. Granada is a city in Spain.

Granite Cloth. A very strong twill-woven wool fabric, used for girls' dresses. In order to be serviceable, it is woven irregularly to form a pebbled surface.

Grenadine. Originally a plain, openwork, net-like fabric of silk, mohair, cotton, or wool. We have grenadines in Jacquards and in set patterns. The name is an adaptation of Granada. It is woven as a gauze weave.

Henrietta Cloth. A twilled cashmere of light weight and high finish, originally made with silk warp and wool filling in Yorkshire, England. The name was given in honor of Henrietta Maria of England, queen of Charles I. The silk warp, hand-woven fabric was first produced about the year 1660. To-day Henrietta cloth is used for housedresses and school dresses. It is a light-weight, soft-woven wool fabric, with a twill weave resembling a Cashmere fabric, although the twill is steeper and more regular, and the surface has a higher luster.

Homespun. A rough, loosely woven material made from coarse yarn. It is soft but rather clumsy. A general term used to designate cloth spun or wrought at home. The homespun of the present day is a woolen fabric in imitation of those fabrics made by hand before the introduction of textile machinery. It is made of a coarse, rough, and uneven yarn of long staple; usually of plain twill weave and no felting. It was woven by the early settlers of the Eastern and Southern States. It is now used as woolen suiting for men's wear and in various kinds of coarse, spongy, shaggy cloth for women's sport clothes. The difference in quality is due to the kind of wool used and the care in finishing. It is dyed in the stock, and various colors of wools are blended to produce the mixed color. Sometimes camels' hair, mohair, and alpaca are mixed with a poor quality of wool to give body to the cloth.

Hop Sacking. A coarse bagging made commonly of a combination of hemp and jute, used for holding hops during transportation. The name hop sacking is also applied to a variety of woolen dress goods made from different classes of yarn. It is made of carded woolen fabric of the plainest kind. The cloth is characterized by an open weave and a square check-like mesh, the structure being designed to imitate that of the coarse jute bagging. It has very little finish, is usually dyed in solid colors, and is used for women's and children's dresses.

Indigo Blue. This term is applied to fabrics dyed with indigo, which is a very fast color and is often called

a vat color on account of the method of applying the dye. Sometimes this term is applied to navy blue fabric used in the manufacture of men's suits and particularly for the uniforms of members of the army and navy.

Jeans. Cotton or woolen coarse twilled fabric. In cotton, used for linings; in wool, for men's cheap clothing. The name is from a Genoese coin, relating to the price of the cloth — so much for one jean.

Kersey. Originally used for overcoatings, is a very heavy, felted, satin finish woolen cloth made with the cotton weave or cross twill for face, and four-harness satin for back. It was originally made with fine Merino lamb's wool for face, and somewhat coarser grade for back. The cheaper grades are manufactured from a fine-fibered wool and shoddy, with low grades of shoddy and mungo for back. It is named from an English town, Kersey, where from the eleventh to the fifteenth century a large woolen trade was carried on. The Kersey of early history was a coarse cloth, known under different names, and before knitting was used for stockings. To-day the Kersey has a thick, compact nap resembling broadcloth. It is very durable and warm.

In the construction of Kersey the cloth is woven a few inches wider in the loom (and correspondingly longer) than it is to appear in the finished state. This is done in order that the meshes may be closed up in the fulling mill to insure a covering of threads. Previous to fulling, however, the face of the cloth is gigged

to produce a good covering for the threads by forming a light nap, which is fitted in. In the fulling operation, which comes next, the cloth is shrunk to its proper width and density, usually to a degree rendering it difficult to see the individual warp and filling threads, so closely are they matted together. Fulling is followed by gigging, and in this process a nap more or less heavy is raised on the face of the goods by means of teasels. The cloth is run through the gig several times and then sheared in order to render the fibers forming the nap short, and of uniform length. Great care is exercised in the shearing, as the nap must be cropped quite close and yet not expose the threads or cut the face. The next operation is scouring or steaming, in which live steam is forced through every part of the goods for the purpose of developing the natural luster of the wool. In case the goods are to be piece dyed, the dyeing follows scouring. After steaming, the cloth is thoroughly matted and gigged again, care being taken to avoid stirring up the ground nap. It is then dried and the nap briskly brushed in a steam brusher and laid evenly in one direction. Again the cloth is slightly steamed and primed, face up. The result of this treatment is the production of a texture firm, yet pliable, with a highly lustrous face and one not liable to wear rough or threadbare. The qualities vary according to composition and finish. The lower grades contain a large percentage of shoddy and are really inferior grades of broadcloth. The better grades are made of good long staple wool and may be of a dull or lustrous

finish. The latter finish is due to heavy hot pressing. It resembles broadcloth, although it has a heavier compact nap.

Kerseymere. Light weight twilled worsted; same derivative of name as Kersey.

Linsey Woolsey. Coarse cloth of linen and wool used as skirtings by the British peasantry. The name is from the components of the cloth.

Mackinaw. Originally the name applied to an extra-heavy, blanket-like material used in cold climates by miners and lumbermen for shirts and underwear. To-day it applies to a soft, heavy woolen cloth napped on both sides and made up in fancy plaids in high colors. Since it is subject to heavy wear, it must be composed of coarse stock and heavy filling. The yarns are soft and heavy and are composed of coarse wools or mixtures of coarse wool and shoddy, or cotton used for warp and shoddy or wool waste for filling. The fabric after weaving is fulled, scoured, napped on both sides, and sometimes waterproofed. If the fabric is woven as a double cloth, it receives a slight fulling. The qualities vary with the composition and finish.

Melrose. A double twilled silk and wool fabric; named for Melrose, a town on the Tweed, in Scotland.

Melton. A thick, heavy, woolen fabric with short nap, feeling somewhat rough. Meltons are made firm in the loom. The weaves for single-cloth meltons are usually plain, and three or four harness twill. For double cloths the plain weave is used, or a weave with a plain face and a one third weave on the back. All

trace of the weave is destroyed in the finishing. The colors are usually black or dark blue. The qualities vary as to composition, structure, and finish. Sometimes a cotton warp is used for the lighter weight fabrics. It is the most compact and heavily felted woolen fabric, heavier than a kersey and has a shorter nap, without the luster. It is very warm, has a good appearance, keeps its shape, and is not pliable — due to heavy fulling. In fact, it is too heavy except for heavy overcoating.

Meltonette. A cloth of the same general appearance as melton, of light weight, for women's wear.

Merino. A fabric woven of the wool of the Merino sheep, twilled on both sides, the twill being uneven. Merino resembles Cashmere.

Mixture. A descriptive name applied to various cotton and wool dress fabrics characterized by a mingled or mottled color effect. Usually the color of mixtures inclines to a grayish shade, and is produced either by the use of white or black warps combined with a gray filling, or by thoroughly mixing two or more colors in one thread of both warp and weft. Whichever way the mixture is produced, the yarn is always dyed, as the effect cannot be brought out by piece dyeing. Worsted mixtures embrace all goods into the composition of which worsted yarns of a mixed color enter, and may be made entirely of wool or with a cotton warp and worsted filling.

Mohair. There is a large number of fabrics on the market composed of all mohair or in part with

cotton, wool, or silk. These fabrics are used for summer suitings, bathing suitings, linings, etc. For these, mohair is used because of its physical properties of luster, stiffness, coolness, resistance to rain and dust. Since it is stiff it will not wrinkle and does not require a lining to hold its shape.

Mohair Brilliantine. A dress fabric resembling alpaca, of superior quality, and sometimes finished on both sides. The name is from the Arabic *mukayyan*, cloth of goat's hair. It is made from the long, silky hair of the Angora goat of Asia Minor, a species which is being introduced into the United States. The fabric has a hard, wiry feel, and if made from the pure material has a high luster. It has cotton warp and luster worsted filling. The weave is plain ground, or with a small Jacquard figure, and when a very lustrous fabric is wanted, the warp yarn is of finer counts than the filling yarn. The warp and filling yarns are dyed previous to weaving. They may be of the same color or different colors. The contrast of colors in connection with the weave gives the fabric a pretty effect. Fabrics made with dyed yarns are usually given a dry finish, that is, simply run through the press and cylinder heated, after which they are rolled and then packed. Those made with undyed filling are first scoured, then dyed, after which they are run through a rotary press with fifty or sixty pounds of steam heat. Mohair brilliantine is used for dress goods.

Montagnac is heavy overcoating. The French *montagne*, for mountain, is the origin of the name, being

for mountain wear. To-day the term is applied to a soft, fleecy fabric with a thick, curly nap, used for men's coatings. The fabric is made of fine, soft wool yarn, woven with a twill weave for weight, and then finished heavy as follows: fulled, washed, napped, cropped to even nap, and dried. It is then put through a whipping machine which makes the nap stand up straight. The nap is dampened without wetting the cloth and then dried by hot air, which causes the nap to curl back. It is not sheared or pressed. Because it has such a heavy curly nap it is very warm. The difficulty in producing the curly nap makes it a higher priced fabric than chinchilla.

Mousseline de Laine. This name is French for wool muslin and is applied to a fine, light, plain woven worsted fabric, used for dresses. It is made of fine worsted warp and filling or cotton warp and worsted filling. It may be dyed or printed. The qualities vary according to the composition.

Orleans. A cloth of cotton warp and bright wool filling, made in Orleans, France. Many of the so-called alpacas and mohairs of to-day are Orleans. These fabrics are mostly cross-dyed, that is, fabrics with warp and filling of different shades. After weaving they are cross-dyed or redyed to give solid colors and glacé effects.

Oxford Mixture. A term used in the woolen trade to denote a color effect in which a black or dark steel ground is flecked with white. The effect is produced by combining two threads of the proper colors into one

yarn in the spinning process, or by blending two shades of raw wool in the carding process.

Palm Beach Cloth. This fabric is used for summer suitings for men and is consequently used without lining. It is composed of mohair or alpaca and cotton. The mohair or alpaca with its stiffness retains the shape, and the cotton makes it cool. It is not tightly woven, and under friction the cloth does not wear well. Otherwise it is dressy and cool.

Panama Cloth is a plain weave worsted fabric of no uniform construction or finish. Fabrics sold under this name vary considerably. They are of solid colors, usually piece dyed, and are used for suitings. They are strong, do not wrinkle, and resist the dust.

Polo Cloth. A durable fabric for coats. It is made of loose-spun yarn which can be easily napped on both sides so as to appear very warm.

Poplin. A strong, durable fabric, with a fine rib effect in the filling, composed of all worsted, silk and worsted, or cotton and worsted. It is used for dresses, coats, and shirtings. Most of the poplins are made of French spun yarn, and the rib effect is produced by using a larger sized yarn in the filling than in the warp. The all-wool fabrics are piece dyed, but the union fabrics are yarn dyed. The finish is clear and lustrous. The value of the fabric depends on the composition and grade of yarn.

Prunella. From the French *prunelle*, which means plum, a stout worsted material named from its color, which is a purplish shade similar to that of a ripe plum.

The name was originally applied to a kind of lasting of which clergymen's gowns were made. It is now used to denote a variety of rich, twilled, lustrous worsted cloth. Prunella is dyed either in piece or yarn state and is hand finished. It is used chiefly for skirts and shoe tops. The fabric is very closely woven, with a pronounced steep twilled effect — more so than other similar fabrics. Because of this it is very serviceable, nearly waterproof, resists dust, and can be easily cleaned.

Ratine. The same as éponge. A rough, spongy cloth, used for dresses and coatings. The effect is produced either by novelty yarns or terry weaving. Because of the softness of the yarn and loose weave it stretches, and the loose projecting yarns catch.

Sacking. Plain solid color flannel in special shades for women's dressing sacks; the name is also applied to a fabric made of hemp for grain sacks.

Sanglier. A plain fabric of wiry worsted or mohair yarn, closely woven, with a rough-finished surface. *Sanglier* is French for "wild boar," the hairy, wiry cloth resembling the coat of the animal.

Sebastopol. A twill-faced cloth named from Sebastopol, the Russian fortified town captured by the English and French in 1855.

Serge. Under this name are classed a large number of fabrics of twill construction with a pronounced diagonal effect. In weight and texture a modern serge resembles flannel, except that it is twill woven and composed of fine yarn finished with a smoother surface.

Serge comes from the Italian word *sergea*, meaning cloth of wool mixed with silk. Serges are woven of worsted, of silk, or of cotton yarn, and variously dyed, finished, and ornamented, as silk serge, serge suiting, storm serge, mohair serge, etc.

French Serge, Fancy. A very fine, light weight, soft, firm fabric made of French spun worsted yarn; used for women's and children's dresses. It is not so stiff as the ordinary serge, because of the softness of the yarn, and is inclined to become shiny with wear. The narrow wale is used for both men's and women's suitings.

Worsted serges of various kinds and degrees have been known since the twelfth century. Worsted serge appears to have come into general use as a material for men's wear in the sixteenth century. Modern serges vary but little from those made two centuries ago. They are dyed in a great variety of colors. On leaving the loom the cloth is washed and scoured with soap and water to remove the dirt and oil (if these remain the cloth will not take the dye properly). After dyeing, it is passed through a pair of metal rollers under pressure, which renders the surface more regular and even and of a better luster. This process accomplishes more than is required, for it produces a bloom on the surface which will show rain specks when in the garment, if it is allowed to remain. This is ordinary serge. In order to make storm serge it is necessary to remove part of the bloom, and to accomplish this the cloth is steamed sufficiently to neutralize the effect of pressing.

Steaming deadens the bloom and prevents the effects of rain showing on the cloth. It is usually made of single yarn in both warp and filling and weighs about 7 ounces per yard.

The wearing qualities of serge are good, but it gets a shine easily. It is used for dress goods and suitings. Serge suiting used for men's clothing is a variety of light, wiry, worsted yarn woven with a flat twill, and dyed black or in shades of blue, fifty-four inches in width. *Mohair* serge is woven with a cotton warp and a mohair filling, thirty-two inches in width. This is dyed in a variety of colors and largely used as lining material for women's clothes, men's coats, and overcoats. *Storm* serge, designed to withstand exposure to stormy weather, is a coarse variety of worsted dress goods produced in a wide range of colors and qualities. The twill is wider, the texture stouter, and the surface rougher and cleaner than that of ordinary serge. *Iridescent* serge is a variety of worsted dress goods woven with warp and filling of different colors, causing a shimmering or iridescent effect. *Cravenette* serge is a fine twilled variety having a firm, closely woven texture, dyed black and in colors, and is used for women's gowns, men's summer suits, etc. *Serge de Barry* is a high grade dress goods of fine texture, with fine twill and wiry feel.

The qualities of serge fabrics vary with the composition, ply of yarn, and finish. All kinds of wool are used, from low grade to fine Australian. Sometimes a cotton warp is used. Very good grades of single

ply are used for ladies' suits, dresses, etc. The better grades are made of two-ply yarns, while the lower grades are made of single yarns.

Shepherd Plaid. A fabric composed of woolen or worsted yarns, with uniform checks of white and black or some other color, used for suitings, and for coats for men and women and children. Such a fabric is more or less a sport fabric as the checks are tiresome to the eyes. The different qualities depend on the composition and color. The worsted holds its shape but is inclined to become shiny with constant wear. The woolens and cottons do not hold their shape.

Silvertone. A novelty woolen fabric with little particles of short silvery threads appearing on the surface to give it a frosted appearance. This fabric is used for winter overcoating. The woolen yarns are made of blended wools of different colors, including fibers of silver, gold, etc., in the yarn. In finishing, the fibers appear on the surface. The wearing qualities are about the same as those of any light napped fabric; that is, with wear the projecting fibers disappear and the cloth looks faded.

Sicilian. A heavy weight, cotton-warp, mohair-filled cloth. Sicilienne, the proper name, was made in the Island of Sicily as a heavy ribbed, all-silk fabric.

Sultane. Twilled cloth of silk and wool; finished in the rough, not singed or sheared. The name is from Sultana, the first wife of the Sultan.

Tamise. Similar to étamine, with a very close mesh, made first of silk and wool. *Tamis* is French for sieve.

Tartans. Plaids of the Scottish clans worn by men in the Highlands of Scotland as a diagonal scarf, fastened on one shoulder and crossing the body. Each clan had a distinctive tartan or plaid. The name was adapted from the French *tiretaine*, a thin woolen checked cloth.

Thibet. A heavy, coarse weave of goat's hair, made by the Thibetans in Asia for men's wear. To-day it refers to a thick, heavy overcoating. It is naturally warm and durable, although rather expensive.

Tricolette. A fine knitted fabric made of artificial silk, used for dresses, suits, sweaters, scarfs, etc. Since it is a knitted fabric it is elastic and clings to the body. It comes in either tubular (circular) or flat form, depending on the type of machine on which it is made. For scarfs the circular fabrics are preferred. The disadvantage of a knitted fabric is that when a thread breaks there is no way to stop the run. This has been partly overcome by the lock stitch. It is cool cloth, due to the artificial silk. When made into garments it is very stylish for stout people because it gives a long line, loose effect, and does not require any fullness.

Tricot. Originally a name given to fabrics made of woolen yarn or thread by hand knitting, from the French word meaning knitting. The term was later applied to materials made on a knitting frame and now known as jersey cloth. Since 1840 the name tricot has been applied to finely woven woolen cloth, the weave of which is intended to imitate the face effect of a knitted fabric. The fabric is composed of woolen and worsted fibers, sometimes with cotton warp woven so as to hide

the cotton in finishing. The tricot line is similar to the rib line in a ribbed cloth except that it is not so pronounced. All tricots are constructed with two sets of warp thread and are characterized by a texture which, while dense, is singularly elastic, in this respect being somewhat similar to heavy jersey cloth. Tricots are commonly dyed in plain colors, and are finished clear so as to show the filling. When intended for trousers they are ornamented with small, neat patterns.

Tricotine. This is a woven fabric made to resemble a knitted fabric, and is used for coats, suits, dresses, etc. In order to make it look like a knitted fabric it is made of soft spun worsted with a twill weave resembling the rib effect of a hose. The double ridge effect makes the interlacing more pronounced. Since it is woven it is stronger than a knitted fabric, wears well, is warm (because it is composed of soft spun wool), and retains its shape (being composed of worsted yarn). The fabric is soft and does not shine as quickly as serge.

The name was originally applied to a fairly fine, gauze knitted fabric, but to-day it is applied to a fine twilled worsted fabric with a warp rib effect. This rib effect is obtained by groupings of two single ends with a distinct space between each group. It is made with single yarns in both warp and filling.

Tweed. A rough, unfinished fabric of soft, open, and flexible texture, of wool or cotton and wool, usually of yarn of two or more shades; originally the product of the weavers on the bank of the river Tweed in Scotland. The face of the cloth presents an unfinished appearance

rather than a sharp and clearly defined pattern. It resembles cheviot and homespun, but is of closer construction. Tweeds are usually made of coarse one-quarter plied wool and are stock dyed, although some are made of fine Saxony and Australian wool. The cloth is woven with either a plain or twill weave, with either two-ply yarn or two-ply in the warp and a coarse single filling. The attractiveness of the tweeds is due to the coloring produced by the ply yarn composed of colored singles. They have checks, twills, or herring-bone patterns. The Scotch tweeds are popular because the coloring is very fine and has been copied from cloud effects, heather (name of a flower), bracken (fern), and grasses on the moors (waste marshy lands) of Scotland. This fabric is finished as follows: slightly fulled, scoured, dried, steam brushed, lightly shorn, and pressed. It is used for dresses, suits, and coats. Like all woolens, it wears well and does not soil, on account of the color, although it does not hold its shape or tailor as well as worsted.

Veiling includes light weight, usually plain weave fabrics of various constructions; generally made with singed or polished yarns. They are in solid colors. The use is designated by the name.

Velours. This term is applied to a group of fine woolen fabrics with a soft, velvety nap, used for coats, suits, and dresses. They are made from good felting wools that are stock dyed, and the yarn is woven by a plain weave. The fabric is finished as follows: well fulled, napped, wet brushed, dried, brushed, steamed,

sheared, sprayed, and pressed. A velour is a napped and not a pile fabric. The qualities vary according to the composition and the grade of yarn. Like all napped fabrics, it catches the dirt and is hard to keep clean. The nap wears off and it looks shabby. On the other hand, it looks warmer than a smooth-faced fabric and makes an excellent winter material.

Venetian. Venetian cloth has a worsted or cotton warp and worsted filling; named from Venetia, a district around Venice. The warp yarns are firmly twisted, the twist being in the direction opposite to the twist in the filling yarn. Venetian is a trade term of wide application, in use since early times as a descriptive title for various fabrics, textures, and garments. One of the many varieties is a species of twill weaving in which the lines or twills are of a rounded form and arranged in a more or less upright position, hence a closely woven worsted cloth. The name is also applied to other fabrics, as a twilled lining fabric woven with a cotton warp and a worsted filling known as Italian cloth. To-day it refers to a closely woven woolen or worsted fabric composed of single yarn, used for coats and suits. It has light weight and plain colors with mixed effects and closely sheared nap. It is finished smooth so as to show the yarns prominently. Venetian cloth has not so much felting as broadcloth; it shows the weave more, but has the same lustrous finish. It resembles covert cloth, although the latter is woven with two-ply yarn. The qualities vary according to the composition and method of dyeing.

Vigogne or **Vicuña.** A soft wool cloth of the cheviot order, with teasled face, made from the wool of the vicuña, a South American animal. Vigogne is the French name for the animal.

Vigoureux. Originally a name applied to a plain or twill mixture, woven of undyed natural wool yarns. The French spinners found that the strongest yarns were those of the undyed wool. The name is French for strong. To-day it is a top printed worsted.

Voiles. Voiles are plain weave worsted, cotton, or silk fabrics made with hard-twisted yarns. The qualities vary according to the quality of yarn. They require a fine hard-twisted yarn in order to make a clear surface. The tendency of excessive twist is to make yarn stiff and wiry, and it is desirable for voiles to be soft. Due to the firmness of the yarn, they give good service and do not wrinkle. As clear a face as possible is secured in finishing, the cloth being singed closely if the yarns are not made comparatively free from loose fibers before being woven. Voiles are dyed in solid colors, and are used principally for dress goods.

Whipcord. A hard-twisted worsted twill, either solid or with mixed colors. The name is from the corded lash of a whip. To-day it refers to strong worsted fabric with a round diagonal rib on the face, and is used as a dress fabric. The diagonal effect is more prominent than in gaberdine or serge, due to the weaving. It naturally looks coarser on account of the pronounced twill effect, but is a very serviceable fabric. It is composed of coarse wool. The two-ply yarn in

the warp is woven in such a way as to float over the single filling yarn. It is either yarn or piece dyed and is finished with a polishing machine which gives the fabric a smooth gloss. It is singed and pressed.

Woolens. Woolen fabrics are made of woolen yarns. They have usually a fuzzy surface and must have considerable coloring to make the fabric attractive. This fabric does not shine, but the nap wears off in parts exposed to friction.

Wool Crash. This term is applied to a light, coarse woven fabric made in imitation of linen crash. It is made of two-grade wool spun into rough, hard-twisted yarns. It may be stock or piece dyed. It is not fulled, but sheared and pressed. It is used for summer suitings.

Worsteds. This term is applied to any fabric made of worsted yarn — which means that it is made of combed wool. The yarn may be smooth, firm, and even, or soft and spongy. The first is produced on cap or ring spinning frames, called the English or Bradford system; the latter is produced on mule spinning frames, called the French system. Worsted fabrics have a clear finish; the weave is the attractive point and gives a clear-cut appearance.

Worsted Diagonals are characterized by prominent weave effects running diagonally across the cloth. The goods are usually of a solid color, and are given a finish which brings the weave into prominence. Diagonals are used for suitings.

Finished Worsted is woven with yarn having a considerable twist, and finished in such a way as to show

the construction of the cloth clearly. The finishing consists simply of scouring the cloth and then passing it through hot water baths between heavy rolls to remove all the soap. It is then sheared and pressed.

Unfinished worsted is a fabric woven with yarn with very little twist in it, and finished so as to make it appear covered with loose fibers, concealing the twill effect. After leaving the loom the cloth is placed in a fulling machine which condenses the fibers, thus increasing the density. It is then passed over hot presses after a slight shearing. It may be made of French spun yarn, or a worsted warp and a woolen filling. This fabric may look like cheviot, but the weave is more open. Cheviot has a crisper or harder feel.

Zephyr. Light worsted yarn, also light weight cotton gingham. Zephyr is Greek for the light west wind.

Zibeline. Originally a cloth manufactured with Merino lambs' wool for warp, and a light wool mixed with camels' hair for filling; or worsted warp and camels' hair for filling; or either of the foregoing warps and a mixture of wool, camels' hair, and fine cashmere for filling. It is used for ladies' tailor-made coats or suits, according to weight. The name is derived from the Latin word *sabellum*, meaning sable, and was applied originally to a variety of long-haired fur generally thought to be the same as sable. Zibeline has long hairs on its right side, some grades being almost like fur. To-day the name is applied to a thick woolen fabric with long, straight, flattened-down nap and a high luster, used for winter coats and suitings. It is made of heavy, coarse yarn

composed of wool and mohair, woven as a single or double cloth for weight, warmth, and durability. It is fulled, wet napped, brushed, steamed, dyed, and pressed. The mohair is used to give stiffness to the nap. The qualities vary according to composition, care in manufacture, etc.

QUESTIONS

1. Distinguish between a melton and broadcloth.
2. Distinguish between kersey and cheviot.
3. Distinguish covert cloth from whipcord.
4. What is the difference between a woolen and an unfinished worsted? Explain in detail.
5. Distinguish
   (*a*) Melton from kersey.
   (*b*) Whipcord from gaberdine.
   (*c*) Poiret twill from tricotine.
   (*d*) Tricotine from whipcord.
   (*e*) Poiret twill from twillcord.
   (*f*) Serge from storm serge.
   (*g*) Storm serge from French serge.
6. Is there any way to tell whether a yarn is French spun or Bradford spun?
7. Distinguish
   (*a*) Prunella from serge.
   (*b*) Flannel from broadcloth.
   (*c*) Frieze from silvertone.
   (*d*) Chinchilla from frieze.
8. Obtain samples of woolens and worsteds. Describe and identify them.

CHAPTER XII

COTTON

Cotton. Cotton is the most important vegetable fiber used in spinning. The cotton fiber is a soft, downy substance which grows around the cotton seed. When examined under the microscope it appears as a long, twisted cell. Owing to the fact that the cotton-plant yields so readily to the varying conditions of soil and climate, there is a large variety of cottons, each having some peculiarity which places it in a distinct class.

An idea of the number of species of the cotton plant can be obtained from the fact that the United States Department of Agriculture has recorded about one hundred and thirty varieties. The most important varieties are: *Gossypium herbaceum, G. arboreum, G. hirsutum, G. barbadense,* and *G. peruvianum.* The botanical name of a plant is divided into two parts: first the family name, followed by the species name.

The *Gossypium herbaceum* grows from four to six feet in height and bears a yellow flower. The seeds are covered with a short gray down. The fiber it bears is classed as short. It is found in Egypt, Asia Minor, Arabia, India, and China. The short-stapled variety of Egyptian cotton is from this species.

The *G. arboreum* when full grown attains a height from fifteen to twenty feet. The seed is covered with a greenish fur and is enveloped in a fine, silky down, yellowish white in color. It is found in Egypt, Arabia, and China.

The *G. hirsutum* is a shrubby plant, its maximum height being

about six feet. The young pods are hairy, and the seeds are numerous and covered with a firmly adhering green down. It is probable that this is the original of the green-seeded cotton which is now cultivated so extensively in the Southern States of America, and which forms the bulk of the supply from that source.

The *G. barbadense* grows from six to fifteen feet high; its flowers are yellow and its seeds black and smooth, being quite destitute of the hair that distinguishes other members of the species. It is a native of Barbadoes or has been cultivated there for a long time. Cottons of the finest texture belong to this species — Sea Island and Florida cottons — from which our finest yarns are spun, and it is used chiefly in the manufacture of fine lace. The long-stapled Egyptian and several other varieties are said to be from this stock.

The *G. peruvianum* is similar to the *G. barbadense*. The Brazilian and Peru cottons are from this species.

Cotton Growing Countries. The most suitable situation for growing cotton is between 35 degrees north and 40 degrees south of the equator. The chief cotton growing countries of the world in order of importance are: the United States, India, Egypt, and Brazil. Cotton is also grown in the following countries, but in no quantity or quality comparable with the four named above — the West Indies, the west coast of Africa, Asia Minor, China, and Queensland.

The best soil for growing cotton is a light loam or sandy soil, which receives and retains the heat and at the same time preserves a good supply of moisture. Cold, damp days are not suitable for its growth, while deep rich soils develop too much leaf and stalk. The best climate for the cultivation of cotton is where frost and snow are of short duration, dews are heavy, and the sun bright, warm, and regular. New soils generally produce the best cotton. The character of the cotton fiber is dependent upon three things: the species of the plant, the nature of the soil, and the locality in which it is grown.

Rough Peruvian. The nature of this cotton is *harsh and wiry and resembles wool so nearly that it is almost exclusively used to mix with woolen fabrics.* The staple

is rough and generally strong, and is of a springy tendency, *i.e.*, it does not lie close like American cotton.

East Indian. India depends upon the monsoon for its moisture, and the success or failure of the crop is decided by that phenomenon of nature. Indian cottons as a rule are coarser and shorter than American cottons. The land is prepared before the breaking of the monsoon, and the planting begins after it. There is not the same care bestowed upon the cultivation of the Indian cotton, nor are such improved methods practised as in America. The ancient routine of past generations still persists, and as a consequence the yield per acre is less than one half that of America. Moreover the acreage planted is only about two thirds that of America. The better growths of East Indian cotton were once largely used in this country for filling, owing to their good color and cleanliness; but of late years the consumption has steadily decreased, owing chiefly to the increased takings by the Indian mills, also to the exports to China and Japan, and to the preference shown by English spinners for American cotton.

Egyptian Cotton. Egyptian cotton, on account of its *long staple and silky gloss*, is imported in considerable quantities. Egyptian is largely used in the manufacture of hosiery, and also for mixing with worsted yarn. *Owing to its gloss it is used for mixing with silk,* and *on account of its strength it is made into the finer sewing threads.* Egyptian cotton is sometimes so charged with grease that it has a greasy smell, and to make it workable it is necessary to sprinkle it with whitening. It has been observed that velvets woven (or piled) with Egyptian filling do not finish as well as when picked with yarns made from American cotton, the reason for this being that the greasy nature of the Egyptian cotton fiber often varies in strength, causing

different shades in the finished goods. This greasy nature is said to be due to two things: (1) the fertility of the soil; (2) the extent to which the cell walls of the fibers are developed.

In addition to cotton, other crops are grown in Egypt — rice, sugar, beans, barley, onions, etc. — and the acreage devoted to cotton is regulated to some extent by the prospects as to which crops are likely to pay best. It is calculated that not more than one third of the cultivated area is usually devoted to cotton.

Sea Island Cotton. *This is the finest growth of cotton, and it commands the highest price. The staple, which is long and silky,* varies in length from one and a half to two and a half inches. *It is used for making fine muslins, laces, spool cotton, and other fabrics, and is also largely mixed with silk.* It is said that this cotton was first introduced into America in 1786 from the Bahama Islands, whither it had been brought from the East Indies. It was first cultivated in Georgia, where it was found that the small islands running along the coast were best adapted for its growth, hence the name "Sea Island." It was also grown on the uplands of Georgia, but although remaining good, the quality deteriorated. Counts as high as four hundred are occasionally spun in Sea Island cotton.

Other Varieties. Cotton grown in the Southern States under widely varying conditions of the soil, climate, and care in cultivation, naturally varies in length, strength, and other qualities of staple. Cotton known as *Uplands* or *Boweds* varies in length from

three fourths to one and one sixteenth inches and is used for filling; this is grown in North and South Carolina, Georgia, Florida, Alabama, and Tennessee. Cotton used for twist is grown in Texas, Louisiana, Mississippi, and Arkansas, and the length of the staple varies from one to one and three sixteenths inches. In the swampy and bottom lands in some of the states (notably Alabama, Louisiana, Mississippi, and Arkansas), cotton is grown with staple ranging from one and one eighth to one and one fourth inches. In addition to these, there are especially long stapled growths, known as *Extras*, *Allen Seed*, and *Peelers*, which measure one and three eighths to one and five eighths inches. Of late there has been an extensive demand for long-stapled American cotton (one and three sixteenths to one and one half inches), owing to the development of fine spinning.

Cotton Raising. Cotton is planted with a machine, which puts it under the ground about one and one half to two inches. It is not planted as corn is, that is, dropped so far apart, but is planted in a continuous stream. After the cotton comes up out of the ground, when it is about three inches high, it is hoed by ordinary labor with a hoe, and is cut out or, rather, thinned. This is called " chopping out " and is for the purpose of removing the inferior or weak plants until only one strong plant is left. The distance between the plants depends on the nature of the variety, frequently about twelve inches being left between them.

The American Crop. The first step taken is the preparation of the ground for planting. This begins in the southern part of Texas as early as the middle of January, in Florida about the third week; in Alabama, Georgia, Mississippi, and Louisiana, about the beginning of February; in Arkansas, Tennessee, and South Carolina from about the middle of February to the begin-

ning of March. Actual planting begins according to latitude, principally from the middle of March to the middle of April, and ends in the first half of May. These dates, however, are dependent upon the state of the weather. When the weather is unusually wet the start is late. The plant suffers from the rank growth of grass and weeds, and extra labor is required to keep the fields clean. In abnormally hot weather, especially after rains, the plant sheds its leaves, thus exposing the bolls, which fall off, whereupon replanting becomes necessary. In addition to injuries by the weather the cotton plant is subject to depredations by insects. Of late years the greatest pest has been the Mexican boll weevil.

The cotton plant blooms ten or eleven weeks after planting. An early bloom is taken as a sign of a good crop. When the crop is an early one, picking may commence in the districts in which it ripens first in the latter half of July; but the usual date is the beginning of August, following on in the various districts in succession until the early part of September. The plant goes on fruiting as long as the weather is mild and open. It finishes in the early regions about the beginning of December, the others following through December and closing in the later regions about the middle of January. Frosts play an important part in the ultimate yield. An early killing frost over the entire belt would curtail the size of the crop by 500,000 bales in a season, as was the case in 1909 when about 32,000,000 acres were planted. Light frosts and late frosts do little harm to the cotton plant; in fact, it is contended that the late frosts do much good under certain conditions of the crop, by opening the bolls that otherwise would not open, and thus adding to the quantity of the late pickings. The effect of frost upon the lint so picked is to produce tinged and stained cotton. Early killing frosts occur in some seasons in the early part of November, when much of the yield may be curtailed. When killing frosts occur late in the season, when the fruiting is practically over, they have little or no effect upon the yield except as regards the color.

The ripening of the crop proceeds in three stages, the bolls nearest the ground maturing first, then those around the middle of the plant, and lastly the top crop. Pods half ripe are often

PICKING COTTON

forced open and the fiber sent on with good cotton. East Indian is more highly charged with unripe cotton than American. The work of picking is not heavy, but becomes tedious from its sameness. Each hand as he goes to the field is supplied with a large basket and a bag. The basket is left at the head of the cotton row, the bag being suspended from the picker's shoulder by a strap, and used to hold the cotton as it is plucked from the boll. When the bag is full it is emptied into the basket, and this routine continued throughout the day. Each hand picks from 140 to 180 pounds of cotton per day. The average yield in the South varies from 500 to 600 pounds per acre. Every boll of cotton contains seeds resembling unground coffee; when these have been removed by the gin, there remains about one third the weight of the boll in clean cotton.

History. Long before history was written, cotton was used in making fabrics in India and China. It has been for thousands of years the leading fabric of the East. The Hindoos have for centuries maintained almost unapproachable perfection in their cotton fabrics. It was the Arabian caravans that brought Indian calicoes and muslins into Europe.

Cotton was first cultivated in Europe by the Moors in Spain in the ninth century. In 1430 it was imported into England in large quantities. The section of England about Manchester became in time the seat of the great cotton industry; this was due to the settlement of spinners and weavers from Flanders.

During the reign of Elizabeth, the East Indies Trading Company was established. Not only was cotton imported, but also India muslins. This caused trouble because of the decrease in the demand for woolen goods manufactured in England. A law was passed prohibiting the importing of cotton goods and later the manufacturing of them, but this law was repealed on account of the great demand for cotton materials.

Columbus found cotton garments worn by the natives of the West Indies. Later Cortez found that cotton was used in Mexico; hence, cotton is indigenous to America. In 1519 Cortez made the first recorded export of cotton from America to Europe.

In 1734 cotton was planted in Georgia. Bales of cotton were sent to England, and the manufacturing of cloth was soon under

way. While the colonies were trying to gain independence, England imposed a fine on anyone sending cotton machinery to America, and restrictions were put on manufacturing and imports of any kind. After the War of Independence many of the Southern States began to raise cotton in larger quantities.

The invention of the cotton gin by Eli Whitney was one of the great inventions of the age. While only two pounds of cotton could be seeded by hand by one person in a day, the gin made it possible to do several hundred pounds. At the time of the Civil War the greater part of the cotton used by English manufacturers was imported from the Southern States. The closing of the southern ports during the war affected the cotton industry throughout the world. Large mills in England were closed, and thousands of people were out of employment. Steps were then taken to encourage people of India, Egypt, Central and South America to increase their production of cotton, and from that time on, cotton from these countries has been found in the general market. Cotton is now cultivated in nearly all countries within the limits 45° north and 35° south of the equator.

At the present time the United States ranks first in the production and export of cotton. Of all the states, Texas and Georgia produce the largest amount. About one third of the entire crop is used in our own mills; $250,000,000 worth of cotton is annually exported, principally through New Orleans, New York, Savannah, and Galveston. Three fifths of this quantity goes to mills in England; Germany, France, and Switzerland take a large part of the remainder.

The value of cotton is shown by the fact that about one half the people of the earth wear clothing made entirely of cotton, and the other half (with the exception of some savage tribes) use it in part of their dress.

Ginning. The next operation to which cotton is subjected is that of ginning, or separating the seeds from the fiber. At the present day the devices for separating the lint from the seed are of two classes: roller gins and saw gins.

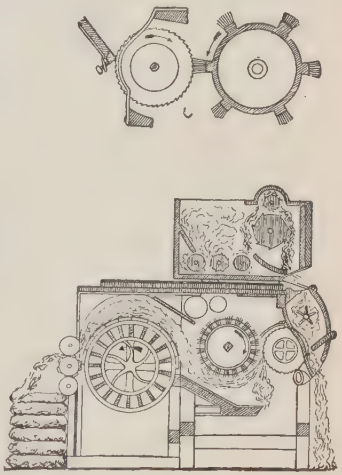
The former device is the more ancient, having been used from the earliest times by the Hindoos. In its simplest form it consists of two rollers made of metal or hard wood, fixed in rude frames, through which the cotton is drawn and the seeds forced out in the process. An improved form of the roller gin is at present used for cleaning the long-staple Sea Island cotton. The saw gin, which works on an entirely different principle, is the machine which, with its improvements and modifications, has been used to separate the seed from fiber almost exclusively for one hundred years in America. In this machine the seed cotton is fed into a box, one side of which is formed of a grating of metal strips set close together, leaving a narrow opening from one eighth to a quarter of an inch wide. Into these openings a row or " gang " of thin circular saws projects, mounted upon a revolving mandrel. The long, protruding teeth of the saws, whirling rapidly, catch the fibers and pull them away from the seeds. The latter, being too large to pass through the openings of the grating, roll downward and out of the machine. The lint, removed from the row of saws by a revolving brush, passes between rollers and is delivered from the machine in the form of a lap or bat.

This machine is responsible for much of the " nep " (or knots) found in American cotton, which is caused when the machine is overcharged. The Whitney gin will turn through more cotton than any other type of machine, and will clean from 200 to 300 pounds per hour. When the machine is running at high speed the tendency is to string and knot the cotton.

The working of the ordinary gin is as follows: The wagon loaded with cotton is driven under a galvanized spout called the sucker, through which there is a suction of air which draws the cotton into the gins. In each of the gins there are seventy circular saws revolving on one shaft. These saws are about one inch apart, and the teeth go through the gin breast, much as if one were to put the teeth of one comb into the teeth of another comb. This process takes the lint cotton off the seed, and by the use of brushes the cotton goes into the lint flute, into the condenser, and into the box, where it is revolved and made into a bale. While the lint is going through this process, the seeds, being heavier and smaller, draw to the bottom of the gins, fall into an augur which

is operated by a belt, and then are dropped into a conveyor and carried to the seed pile or house. The lint goes in one direction and the seeds in another.

When the seed is taken from the cotton at the gin, it is covered with a lint of cotton. In order to remove this the seeds are put through a delinter, which takes off the small, short fiber from the seeds, leaving them clean. This seed is then put through a huller which takes off the outside hull or thick skin. The kernel is then put through a hydraulic press, which squeezes the cotton-seed oil from it and leaves the "meal." Cotton-seed oil is used for many purposes, such as making olive oil, butter or oleomargarine, lard, etc. Of late an experiment has been made with the meal for use in the place of flour, and has been pronounced a success. Seed crushing has now become an important industry, with the cotton crop each year amounting to between 12,000,000 and 13,000,000 bales of 450 pounds each.



COTTON GIN

The upper figure shows Whitney's invention. The lower figure shows a later form.

The Cotton Gin. The cotton gin was invented in 1792 by Eli Whitney, a citizen of Georgia, but a native of Massachusetts. The importance of this invention to the cotton industry of the world cannot be overestimated. It was the one thing needed to insure a sufficient supply of raw material to meet the requirements of newly invented machinery for spinning and weaving. The result of Whitney's invention was the rapid extension of the cultivation of cotton in the United States, and its permanent establishment as one of the leading staples of the country.

Cotton Bales. After the cotton is ginned and baled it is shipped to the mill. The standard size of a cotton bale in the United States is $54 \times 27 \times 27$ inches, and contains nearly 500

pounds. To produce this bale over 1600 pounds of seed cotton are required. The bales are wrapped in jute bagging and strapped with sheet-iron bands, this covering adding about twenty-five pounds to the weight of the bale.

The Bessonette cylindrical bale is turned out by a self-feeding press, which receives the lap of lint from the gin between two heavy rollers. The fiber is rolled upon a long wooden spool so tightly as to press out nearly all the air, and forms a package of uniform shape and size throughout, having a diameter of fourteen to sixteen inches. The bales are covered with cotton cloth, held in place by small wire hoops. It is claimed that the cotton is rolled so tightly by this process that the bales are practically fireproof and waterproof.

Egyptian bales are compressed into a shape similar to the American bale, but the average weight is over 700 pounds.

The Indian bales, which are more closely compressed than the American, usually weigh 400 pounds.

Cotton is purchased by the mill authorities in the shape of a bale. The method is to purchase from cotton brokers, samples being furnished to the buyer from which to make selection.

The commercial value of cotton is determined by its length, fineness, strength, pliability, smoothness, regularity, color, and cleanliness. As a rule, the cotton that is the longest is also the finest, but by no means the strongest. Thus, Sea Island cotton has the longest staple with the least diameter, and Hinganghat (an Indian cotton) is much inferior to it in both respects. The strength of the latter, however, is 50 per cent greater than the strength of Sea Island cotton. In every other respect Sea Island cotton is superior to Hinganghat cotton. It is the most valuable, especially for the production of fine yarns.

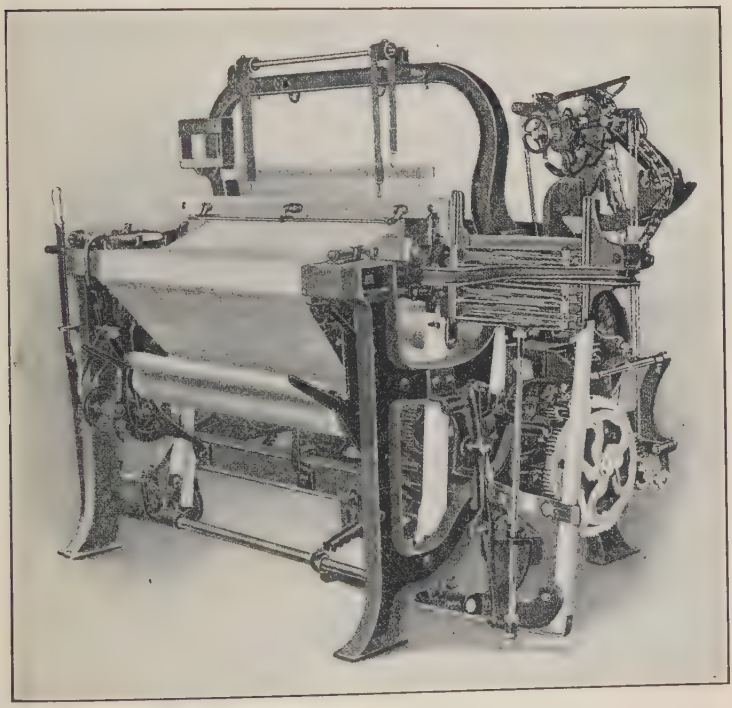
The most regular cotton is Orleans, in which the length of the staple varies only a small fraction of an inch. In

consequence of this there is less loss in working Orleans than is the case with the other cottons, owing to the fact that their fibers vary in length.

The Leading Growths of Cotton. In order to purchase the raw material for cotton manufacture, to arrange the "mixing," or have much to do with the raw material in any other capacity, one should know as much as possible of its characteristics; for ignorance may cause much trouble and no little loss to those who have to spin the cotton. Each crop differs from the previous one to a greater or less degree, as it depends entirely upon the weather. Thus, in a very dry season there is a "droughty crop" which, while it may be (and generally is) clean and well up in class, will be weak, short, and of irregular fiber. In order to obtain the desired length and strength of staple the buyer will have to pay a relatively higher price than in what may be termed a normal season.

Again, in a crop that is poor in class, a defect that may have been caused by too much rain in the early or middle stages of its growth, or by unfavorable weather for the production of cotton of good grade, the staple will probably be all that could be desired, leafy and small, but the buyer will have to pay more to obtain his usual grade, especially if he requires it for good filling. Then there are seasons when the crop turns out fairly well in class and staple, but the cotton is dirty, or abnormally leafy; and in this case the buyer has to exercise great care and judgment in calculating the extra loss that will ensue.

The terms of purchase of cotton include an allowance of 4 per cent for tares. That is, a bale of cotton weighing 400 pounds would be paid for as 384 pounds; or should the buyer have reason to believe that the tares are



FANCY COTTON LOOM

Note the four compartments on the right for shuttles containing different kinds of filling.

unusually heavy, he has the option of claiming the actual tare. This is ascertained by stripping ten bales and weighing the covering and the hoops, which means considerable work, and although it is at the option of

the buyer, to have it done is an exception rather than the rule. Cotton is divided into the following grades:

Grades of Cotton. Egyptian cotton is graded as extra fine, fine, good, fully good fair, good fair, fair, middling fair, middling.

Indian cotton is graded as follows: superfine, fine, fully good, good, fully good fair, good fair, fully fair.

Brazilian cotton may be classed: fine, good, good fair, fair, middling fair, middling.

American cotton has seven grades: fair, middling fair, good middling, middling, low middling, good ordinary, and ordinary.

In addition to the full grades there are half and quarter grades. The American cottons are graded as follows:

Full Grades.	*Half Grades.*	*Quarter Grades.*
Fair,	Strict middling fair,	Barely fair,
Middling fair,	Strict good middling,	Fully middling fair,
Good middling,	Strict middling,	Barely middling fair,
Middling,	Strict low middling,	Fully good middling,
Low middling,	Strict good ordinary,	Barely good middling,
Good ordinary,	Strict ordinary.	Fully middling,
Ordinary.		Barely middling,
		Fully low middling,
		Barely low middling,
		Fully good ordinary,
		Barely good ordinary.

The following are a few of the leading varieties of cotton, with the numbers of yarn they will make:

Cotton.	*Length.*	*Warp.*	*Filling.*
Sea Island (selected) ..... $1\frac{3}{4}$	to $2\frac{1}{4}$	up to 200	250 to 300
Sea Island (ordinary) ..... $1\frac{3}{4}$	to 2	150	220
Florida Sea Island ..... $1\frac{3}{4}$	to 2	150	220
Georgia ..... $1\frac{1}{2}$	to $1\frac{7}{8}$	120	180
Egyptian ..... $1\frac{1}{4}$	to $1\frac{1}{2}$	70	120
Peeler ..... $1\frac{1}{4}$	to $1\frac{3}{8}$	50	70
Orleans or Gulf ..... $1\frac{1}{16}$	to $1\frac{1}{4}$	40	60
Upland 1	to $1\frac{1}{8}$	30	45
Texas ..... $\frac{7}{8}$	to $1\frac{1}{16}$	25	35

During the last few years considerable discussion has taken place among mill men, both in this country and abroad, bearing upon the subject of moisture contained in baled cotton. Of course the natural moisture in the cotton fiber varies, as might be expected, from year to year, according to the character of the season during the picking. The standard of moisture is based upon what is known as regain, that is, if 100 parts of absolutely dry cotton are exposed to the air, they will absorb about $8\frac{1}{2}$ per cent of moisture, although a much higher per cent is sometimes found.

In some of the small Southern mills located in the cotton raising section, the cotton is delivered by team direct from the gin, without going through the compress. In this way they save the greater part of transportation expense. They also save in the strength of the cotton fiber itself, since the process of compression injures the fiber. They get better cotton, being nearer the source of supply and having better opportunities for selection.

When the cotton arrives in the shape of a bale, it is necessary to cut ties and loosen up the cotton before use. This may be done in two ways, one method being to pull the bale apart by hand, and the other to pass it through a bale breaker or similar machine, which loosens up the cotton by means of beaters. It now starts on a continuous journey through successive machines until it is made into yarn. The yarn is made into a warp, and the warp interlaced with the filling yarn to make cloth, and the cloth finished for the market.

Not every country is adapted for making cotton yarn, for certain conditions are necessary to manufacture good yarn. If the atmosphere is too warm or too dry, the fibers will become brittle and will not twist well; if too wet they collapse and stick. Lancashire County,

England, seems to have been fitted by nature for cotton spinning. It has just the right climate, a moist temperature, and copious water supply. There are hills on the east of the valley, forming a watershed, and the

PICKER ROOM

1. Hopper where the cotton from the bale is fed into Picker.
2. "Lap" showing how the cotton is prepared for the card.
3. Picker Machine (complete).

town lies in a basin covered with a bed of stiff clay that holds the water, allowing it to evaporate just fast enough to keep the air in the moist condition needed to fit the fibers for weaving. Countries that have not these conditions are obliged to produce them by artificial means — humidifying, etc.

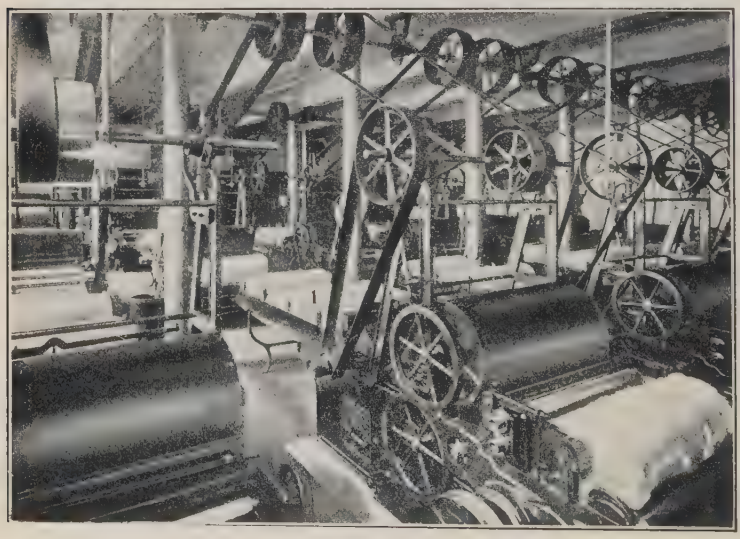
QUESTIONS

1. What is cotton? Is it a seed or stem fiber?
2. Why is cotton so important?
3. (*a*) Describe some of the important varieties.
   (*b*) Give the family name of cotton.
4. Describe some of the important cotton countries.
5. Distinguish between: Sea Island, Upland, and Peeler's cotton.
6. What are the characteristics of Peruvian cotton? Egyptian? American?
7. Describe the raising of cotton in the United States.
8. (*a*) What is meant by the term "cotton ginning"?
   (*b*) Who invented the cotton gin?
9. State briefly the history of cotton.
10. (*a*) Describe the method of buying and selling cotton.
    (*b*) What is the Cotton Exchange?
    (*c*) Why not a wool exchange?
11. (*a*) Is cotton all alike?
    (*b*) Why must it be graded?
    (*c*) Describe the grading of cotton.
12. Why has England maintained supremacy in high-grade cottons?
13. What is "humidifying"?

CHAPTER XIII

MANUFACTURE OF COTTON YARN

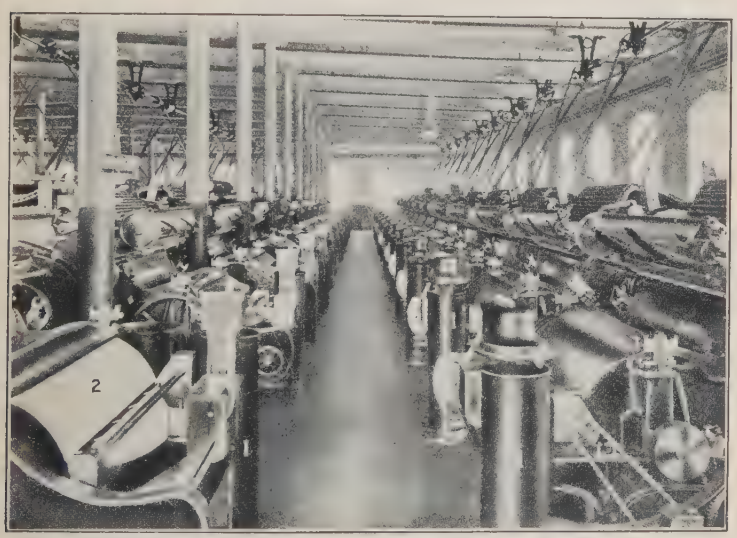
Picker Room. The first step in the conversion of the bale of cotton into yarn consists in giving the cotton fibers a thorough cleaning. This is accomplished



PICKER ROOM — SHOWING END VIEW OF PICKER
1. Lap of Cotton.

by feeding the cotton to a series of picker machines called in order, bale breaker, cotton opener, and automatic feeder, breaker picker, intermediate picker, and finisher picker. These machines pull to shreds the

matted locks and wads of cotton (as we find them in the bale), beat out the dirt, stones, and seeds, and finally leave the cotton in the form of batting upon the cylinders; this batting passes from one machine to



CARD ROOM

1. Roving Can — receptacle to hold the sliver. After it is filled it is transferred to either ribbon lap machine or drawing frame.
2. Cylinder of the card. The cotton is on this cylinder in the form of a web.

another until it issues from the finisher picker as a downy roll or lap.

(Sometimes the bale breaker is not used in the mill.)

Carding Machine. When the lap of cotton leaves the picker it goes to the carding machine, where it is combed into parallel fibers by means of a revolving cylinder covered with wire teeth called card clothing. As the cotton is fed to the card in the form of a sheet or

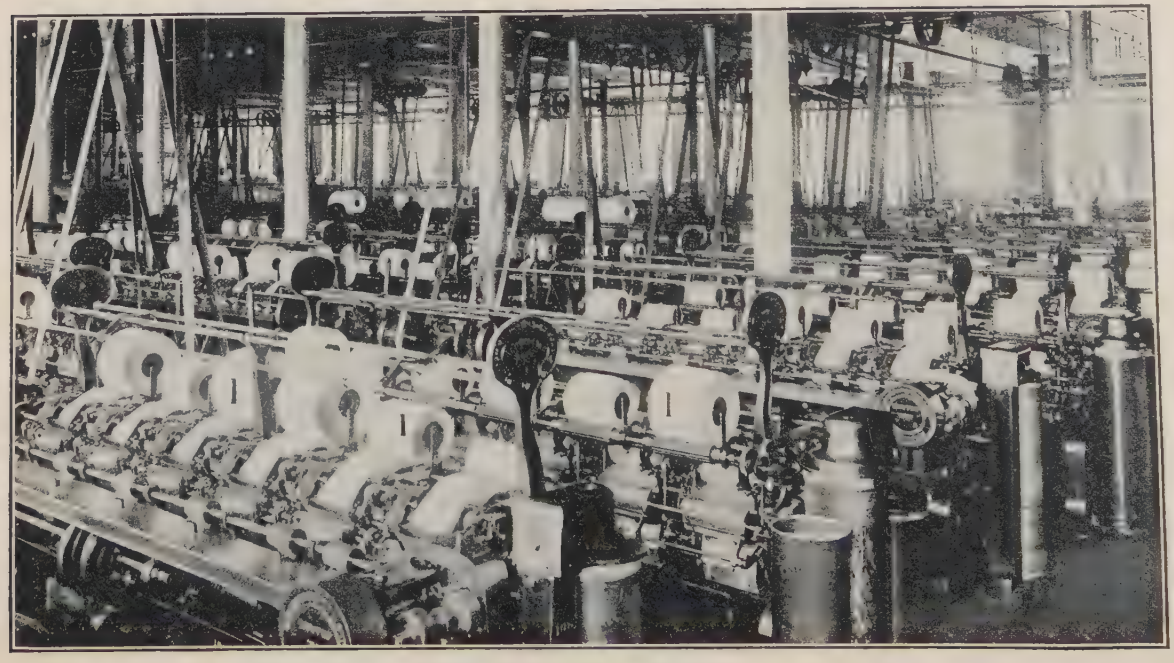
lap from the picker, it is supposed to have been freed from a considerable quantity of sand, seed, etc., but there still remain nep, fine leaf, and short fibers, which are removed during carding.

On leaving the card cylinder the lap has become a gossamer-like web thirty-nine inches broad. This web next passes through small " eyes," which condense it into a narrow band about an inch in width, known as card sliver.

When a lap is delivered from the finisher picker, it should weigh a given number of grains per yard. The method of ascertaining the weight is to make each lap a standard number of yards in length and weigh each lap. The machine can be regulated so as to give the desired weight per yard.

Combing. When an extremely fine and strong yarn is required, in addition to carding, the fibers are also subjected to the process of " combing." This may be said to be merely a continuation of the carding process to a more perfect degree. The chief object is to extract all fibers below a certain required length, and cast them aside as " waste." This is done in order to secure the very best fibers calculated to give the strongest and best results in the spun yarn.

The process of combing follows carding. The card delivers the cotton in the form of a sliver or strand, while the combing machine requires the fibers to be delivered to it in the form of sheets, nine to twelve inches wide. This is done by taking a number of card slivers and forming a lap of them by passing the sliver through a sliver lap machine. The laps are passed through the comber. This machine consists essentially of a series of rollers, nippers,



COTTON COMB ROOM

1. The cotton in the form of a "lap" ready to pass through the comb

and rows of metal teeth. By the action of these, the short fibers are separated and combed out, and the long ones arranged in parallel order in the form of a thin, silky strand, in which condition it is sent to the drawing frames to be drawn out. Of course it must be understood that a combing machine is used by only a small percentage of cotton spinners. For ordinary purposes a sufficiently good quality can be made without a comber. As there is from 15 to 35 per cent waste in this operation it may be readily seen that it is costly and limited entirely to the production of the very best and finest yarns, such as those intended for sewing or machine thread, fine hosiery, lace curtains, underwear, imitation silks, and fine grades of white goods. There are combing machines that comb short staple cotton.

Drawing. The cans containing the slivers are taken from the card or combing machine (as the case may be) to the drawing frame. The object of this machine is mainly to equalize the slivers, combining a number of them together so as to distribute the fibers uniformly. The condition of the fibers on leaving the card or comb is such that a slight pull will lay them perfectly straight or parallel, and this pull is given by the drawing frame rollers. Of course the fibers coming from the comb are parallel, but it is necessary to alternate them by the drawing. The drawing frame is a machine consisting of a number of sets of rollers, the front roller having a greater speed than the rear ones.

The slivers, which are as nearly as possible the same weight per yard, are combined together in the drawing and emerge from the pair of front rollers as one sliver weighing the same number of grains per yard as a single sliver fed up at tle back. This process is repeated two or three times, according to requirements, the material

then being referred to as having passed through so many " heads " of drawing. It is not unusual to pass Indian and American cotton through three deliveries.

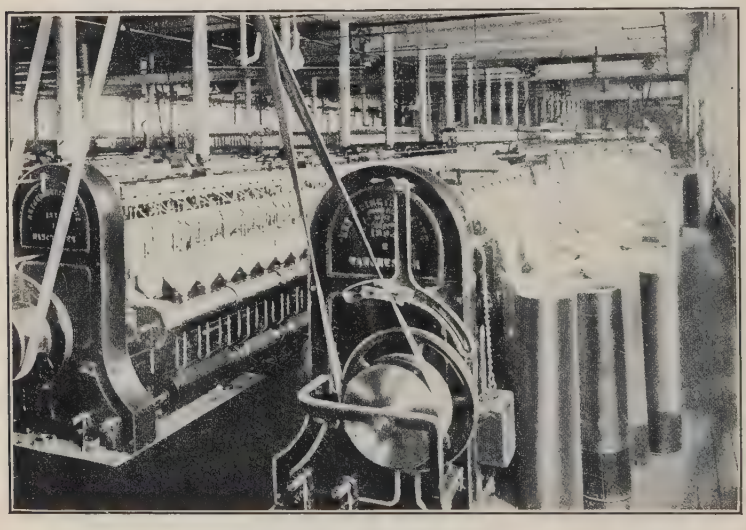
The object of all the processes thus far described has been that of cleaning (in the picker), arranging the fibers in a position parallel to each other, making uniform, and drawing out the stock. In every case the stock delivered from a machine is lighter than when fed into it, and contains just enough twist to hold it together and prevent its being stretched or strained when unwound from the bobbin, and fed into the next machine. The minimum amount of twist in roving is desirable for the reason that it permits the stock to be drawn out more easily and uniformly, the little twist that is put in the roving by the slubber being practically eliminated when it is passed through the rolls of the intermediate. The same applies in the case of the roving passing from the roving to the spinning frame.

Fly Frames. The process in the manufacture of yarn after the cotton has passed through the drawing frame consists of further attenuation of the sliver, but as the cotton sliver has been drawn out as much as is possible without breakage, a small amount of " twist " is introduced to allow the continued drawing out of the sliver.

From the drawing frame, the drawing passes through two-, three-, or four-fly frames, according to the number of yarn to be made. All these machines are identical in principle and construction, and differ only in the size of some of the working parts. They are the slub-

ber, intermediate, roving, — and fine or jack frame, and the function of each is to draw and twist.

Intermediate Frame. The function of the intermediate frame is to receive the slightly twisted rove from the slubber and add thereto a little more twist

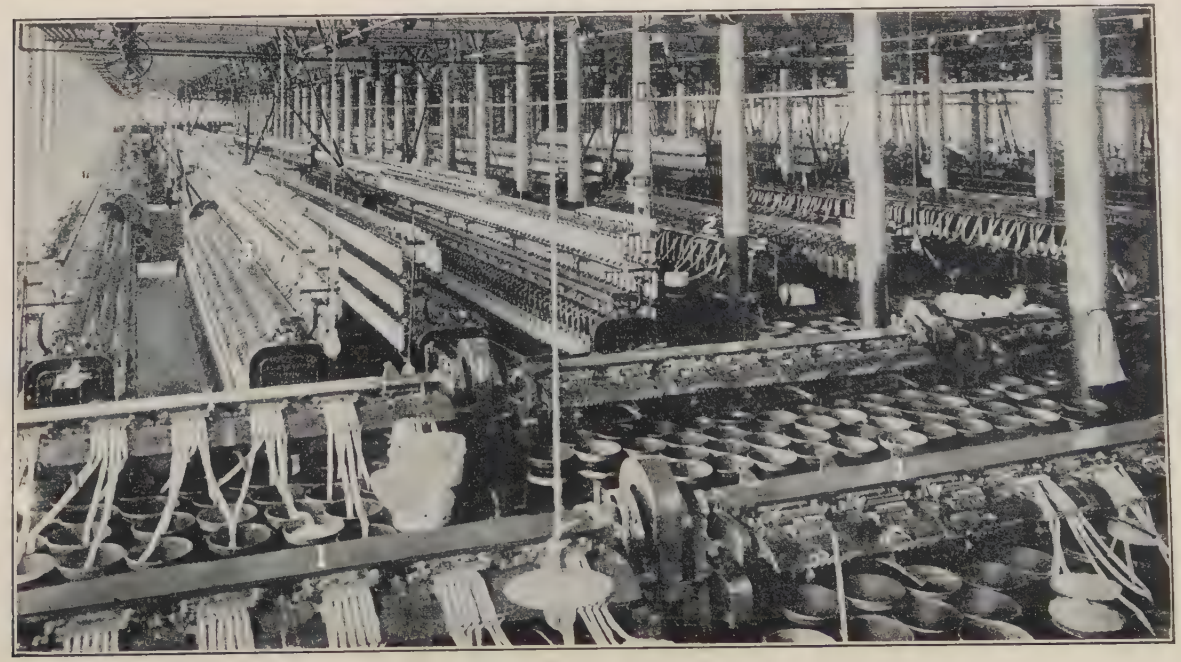


ROVING DEPARTMENT

1. Slubber machine, showing sliver of cotton passing through the rolls and then given a twist while it is wound on the bobbin.

and draft. The rove is taken from two bobbins to one spindle in the machine, an arrangement which tends to insure strength and uniformity. The principle of the machine is in other respects the same as that of the slubbing frame.

Roving Frame. The function of the roving frame is to receive the twisted rove from the intermediate and add more twist and draft, thereby further attenuat-



ROVING ROOM

1. A drawing frame showing the sliver of cotton passing through the machine.
2. A slubber showing the sliver passing through and wound on bobbins.
3. Roving machine showing the cotton passing from one bobbin through the roller to another.

ing the rove. As in the intermediate frame, the rove is generally taken from two bobbins to one spindle.

Fine or Jack Frame. This machine is used when fine yarns have to be made. It is built on the same principle as the preceding frames, the only difference being that a finer rove is made from which finer numbers of yarn can be spun. As in the slubber, intermediate, and roving frames, the rove is taken from two bobbins to one spindle.

Spinning. In the manufacture of single-ply yarn the final process is that of spinning, which consists in drawing out the cotton roving to the required size, and giving it the proper amount of twist necessary to make the yarn of the required strength. While the spinning frame is built on entirely different principles from the roving, intermediate, or slubber frame, the object of each machine is the same as that of the spinning frame. The principal point of difference is the amount of twist imparted to the cotton roving.

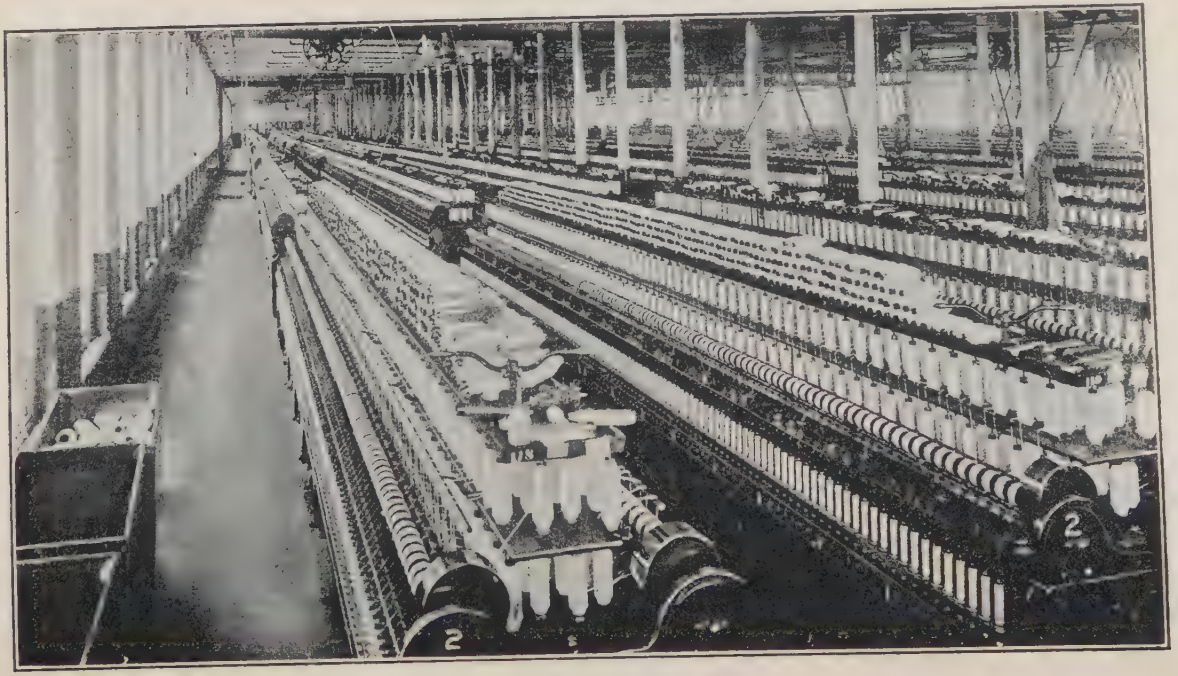
The objects of the spinning process are:

1. Completion of the drawing out of the cotton roving to the required size.

2. Insertion of the proper amount of twist to give the thread produced sufficient strength.

Excessive speed causes defects in the yarn and undue wear and tear on the machine.

There are two methods of spinning: ring spinning and mule spinning. The mule spinning is the older form. There are but few mule frames in operation in this country.



SPINNING ROOM. COTTON DEPARTMENT

1. Humidifier—an apparatus to give off moisture.
2. Spinning frames—showing the cotton as it comes from the roving frame and passes through the spinning frame.

Mule Spinning. The function of mule spinning is to spin on the bare spindle, or upon the short paper tubes, when such are required to form a base for the cop bottom. The mule will spin any counts of yarn required, and is especially adapted for yarn in which elasticity and " cover " are essentials. Hosiery yarns are produced on the ordinary cotton mule and are very soft spun.

The bobbins of roving are placed in a creel at the back of the machine, the strands of roving being passed through the rolls and drawn out in the same manner as at the roving frame. The spindles are mounted on a carriage which moves backward and forward in its relation to the rolls, the distance roved being about five feet. When the spindles are moving away from the frame the stock is being delivered by the rolls, the speed at which the spindles move away from the rolls being just enough to keep the ends at a slight tension. The twist is put in the yarn at the same time.

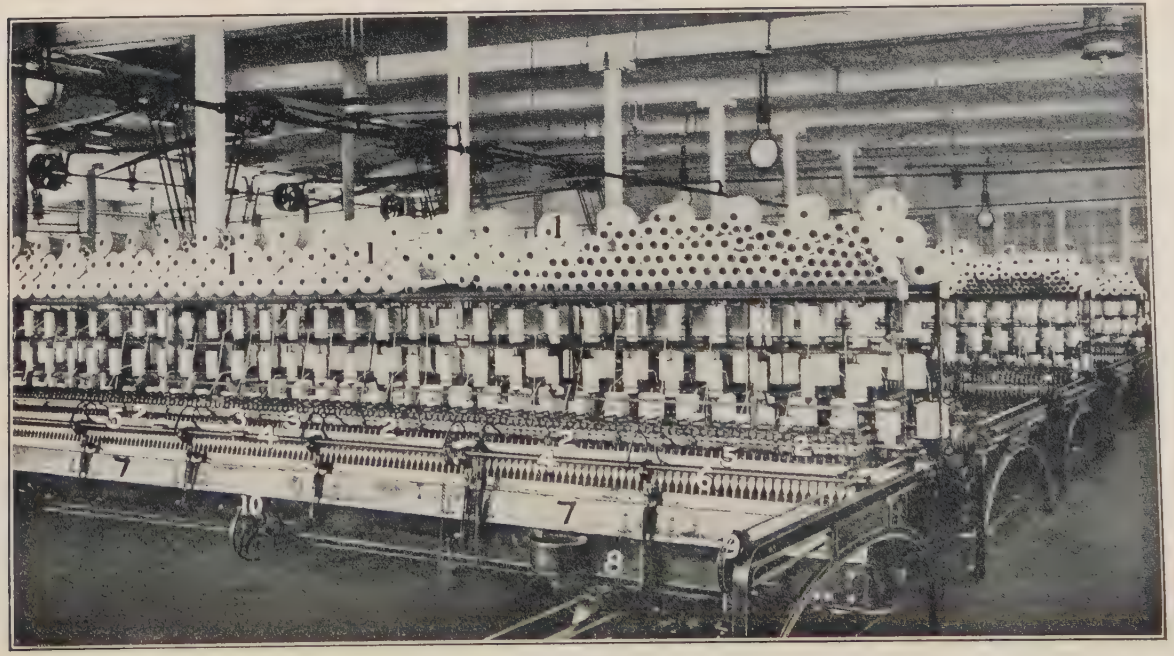
When the spindles reach their greatest distance from the rolls, the latter are automatically stopped and the direction of the motion of the spindle carriage reversed. The yarn is wound on the spindle while the carriage is being moved back toward the rolls, the motion of the rolls being stopped in the meanwhile, the spindles revolving only fast enough to wind up the thread that has been spun during the outward move of the carriage.

The mule is a much more complicated machine than the ring frame, its floor space is much greater, and more skilled help is required for its operation. Under ordinary conditions it is not practical to spin finer yarn than No. 60's on a ring, while as high as No. 500's is said to have been spun on a mule. The same number of yarn can be spun on a mule with less twist than on the ring. This is important in hosiery yarn.

Ring spinning is used for coarse numbers, and has greater production and requires less labor than mule spinning. Ring-spinning yarn is used for warp purposes.

Ring Spinning. The function of ring spinning is to draw out the rove and spin it into yarn on a continuous system. The yarn made is spun upon bobbins.

The ring spinning differs from mule spinning in having the carriage replaced by a ring, from which the machine takes its



MULE ROOM

1. Stocks from Finisher ready to be spun upon the mule.
2. Front Rollers with weight levers.
3. Clearers for Front Rollers.
4. Faller shafts containing Sickles.
5. Spindles.
6. Spun Yarn wound on cops.
7. Covers for carriage.
8. Body of carriage.
9. Drawing out band.
10. One of the wheels for the carriage.

name. The ring is from one and one half to three inches in diameter, grooved inside and out, and is connected with a flat steel wire shaped like the letter D, called the "traveller." Its office is to constitute a drag upon the yarn, by means of which the latter is wound upon a bobbin. Its size and weight depend on the counts of yarns to be spun; coarse yarns demand the largest ring and heaviest traveller.

Cotton Market. Cotton is bought and sold in: (1) raw condition, (2) as yarn, (3) as grey cloth, (4) as finished cloth. There is an open market for each state of the cotton from the raw to the finished condition. Quotations are given in the textile and trade papers from day to day. The following represents the typical quotation for raw cotton:

Extra staple strict middling prices to-day were:
1 1-8-inch, 28½ to 30 cents.
1 3-16-inch, 30½ to 32 cents.
1 1-4-inch, 34 to 35 cents.
1 5-16-inch, 37½ to 39 cents.
Egyptian uppers, medium, 28 to 30 cents
Peruvian mitafifi, 28½ to 30 cents.
High grade sak, 49 to 51 cents.
Sea island, 49 to 51 cents.

Egyptian	
Uppers	30 cents
Saks, fair grade	40 cents
Brazilians	
1 3-16 to 1 1-4-inch	25 cents
Peruvian	
Mitafifi	29 cents
Arizona	
Arizona-Egyptian	38 cents
American Strict Middlings	
1 1-16-inch	21 cents
1 1-8-inch	26 cents
1 3-16-inch	28 cents
1 1-4-inch	32 cents
1 5-16-inch	38 cents

The quotation is expressed in points, each one representing a hundredth of a cent for middling cotton.

Market quotations for other grades are not given on the exchange, but may be computed.

Use of Cotton Yarn. Cotton yarn is used in the manufacture of woven goods, knit goods, braid, lace, embroidery, and sewing thread.

Cotton yarn may be made from upland, Peeler, Egyptian, sea island, or other cotton. It may be carded or combed; ring spun or mule spun; made with varying degrees of twist from XXX soft up to extra hard; in the single, doubled, or cabled; grey, bleached, printed, dyed, or colored; plain or finished (gassed, mercerized, prepared, polished). It may be put up in a number of ways, and may be used for many different purposes. There are many varieties of cotton yarn, and several modifying adjectives are required for the precise identification of any particular count. The cheapest yarns are grey carded singles in coarse counts, whereas the costliest are very fine two-ply sea island lace yarns, combed, bleached, gassed, and prepared.

Cotton yarns are spun commercially from halves up to 400's. The finest ordinarily imported into the United States are 260/2 ply. The normal limit of manufacture in the United States thus far has been 100's warp and 120's filling, although for their own use a few mills are equipped to spin up to 200's if desired. Market quotations are rarely published of counts above 80's. So far as cotton yarns spun for the market are concerned, England supplies the world with those above 100's, and the United States is no exception to the rule.

The number or count of cotton yarn means the

number of 840-yard hanks that weigh 1 pound. Thus, No. 1 cotton yarn measures 840 yards to the pound, whereas No. 100 cotton yarn measures 84,000 yards to the pound; the higher the count, the finer the yarn. This is the English system that is used in the United States, the United Kingdom, India, Japan, and many other countries. The metric system, in which the count indicates the number of 1000-meter hanks that weigh 1 kilogram; the French, or half-metric, system, in which the count indicates the number of 1000-meter hanks that weigh 500 grams; the Spanish, and other systems are in partial use in various countries, but the English system is the one most nearly universal.

Yarn as it comes from the spinning machine is single yarn. If two or more ends are twisted together it is known as ply yarn, twisted yarn, doubled yarn, or folded yarn.

Yarn may be purchased or sold either in skeins, balled or looped chains, or wound on beams or rollers, cones, caps, tubes, or bobbins. It is frequently shipped in skeins to avoid the expense of additional freight on the bobbins, etc. A skein consists of a continuous length of yarn reeled into circular form. The usual cotton skein is made on a reel having a device (called a *swift*) 54 inches in circumference.

The most common yarns are divided into two classes: (1) warp yarns and (2) weft or filling yarns. Since the warp is the stronger part of the cloth, the yarn in the warp must be stronger than the filling. The warp yarn is made stronger than the filling by adding more twists

or turns to the inch. The warp yarn is usually treated with sizing and is frequently bought and sold as a number of ends of equal length placed on round or cylindrical balled chains or on beams or wooden rollers. Hosiery yarns are usually shipped in the cone.

Color. Yarn in its natural cotton color is unbleached yarn, and is usually called grey yarn. Unbleached yarn from the Egyptian Mitafifi is sometimes known as brown yarn because of the distinctive shade of the original cotton. In order to distinguish Mitafifi yarn from the Egyptian Abassi, which is without the brown shade often associated with Egyptian cotton, the Abassi yarn is sometimes known and invoiced as white cotton yarn, although it is unbleached. Besides grey yarns (special varieties being listed as brown or white) yarns may be sold in the bleached, dyed, or colored states. The term "colored" may include dyed yarns, but is usually employed to indicate yarn that is only partially dyed, such as printed yarn or yarn made of one dyed and one undyed strand.

Finish. Cotton yarns may be finished by gassing, mercerizing, preparing, polishing, or other processes.

Market Quotations on Yarns.

Southern Single Skeins

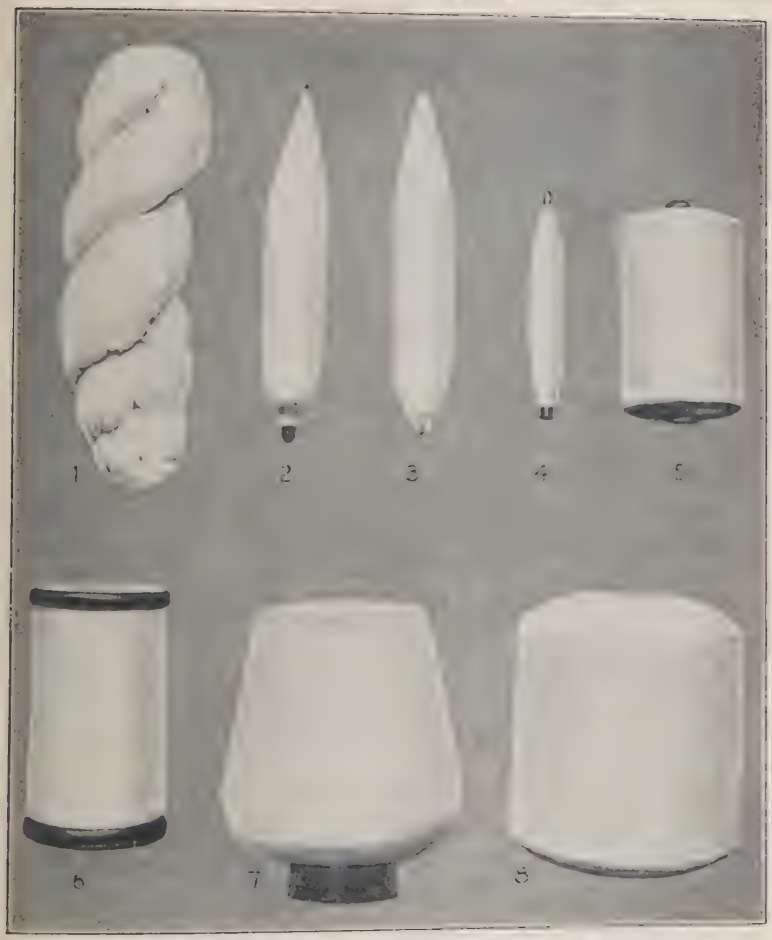
	Dec. 11, 1921	Dec. 11, 1920
4s to 8s	28½	29
10s	29½	29
12s	30½	29½
14s	31	30
16s	31½	32
20s	33	32
24s	34	34
26s	35	35
30s	36	40

Southern Single Warps			
8s	30		30
10s	30½	@31	30
12s	31½		30½
14s	32		31
16s	33		31½
20s	33½	@34	32
26s	35½	@36	35
30s	37		40
40s	52	@54	48

The quotation for two-ply are about one cent higher than for single.

Southern Two-Ply Combed Peeler Skeins and Warps			
8s to 16s	55		
20s	58		60
24s	60		62
30s	65		65
40s	80		70
50s	90		75
60s	$1.05		85
70s	$1.25		95
80s	$1.40		$1.20
Northern Mule Spun Carded Yarn Cones			
10s	34		35
12s	35		36
14s	36		37
16s	37		38
18s	38		39
20s	39		40
24s	41		42
26s	44		42
30s	46		45
40s	58	@66	55
Northern Mule Spun Combed Peeler Yarn on Cones			
10s	46		55
12s	47		56
14s	48		58
16s	49		59
18s	50		60
20s	51		61
22s	53		62
26s	60		66
28s	62		68
30s	65		70
36s	73		76
38s	74		78
40s	76		80

Southern means that the yarn has been spun in a southern mill and is considered a little cheaper, hence the difference in price.



FORMS IN WHICH COTTON YARN IS PUT UP FOR SHIPMENT

1. A skein of yarn reeled on a swift of 54 inches circumference. This is the most typical form of put up. The majority of international trade in cotton yarn consists of skeins bundled and baled.
2. Warp cop. 3. Through-tube cop or pirn. 4. Pin cop.
5. A tube of 140/2 grey carded yarn.
6. A spool (in England called a "bobbin") of 36/1 white polished yarn.
7. One form of hosiery cone. This particular yarn is bleached singles.
8. A tube or cheese of 60/2 combed Egyptian for machine knitting.

1. Sewing thread on spools. Labeled "Machine twist, silk substitute, 100 yards; No. 40." Dyed.
2. Sewing thread on spools. "Soft finish, three cord; 50 yards." Bleached.
3. Sewing thread on spools. "Patent glacé finish; 90 yards." Dyed.
4. Crochet cotton in ball form. 150 yards wound on a core of cardboard tubing. Dyed.
5. Crochet cotton in a minute ball. 64 yards. Dyed.
6. Crochet cotton on flat pasteboard reel. 30 yards. Dyed.
7. Darning cotton in ball form. "Silk finish"; 45 yards. Dyed.
8. Darning cotton on wooden spools. 45 yards. Dyed.
9. Ball of soft spun yarn marked "For crocheting, embroidering, and knitting." 104 yards wound on a core of cardboard tubing. Bleached.
10. A spool, or rather cheese with wooden core, of 3/2 ply black gassed mercerized yarn for embroidering or knitting.
11. A very soft wound ball of knitting cotton. 60 yards. Dyed.
12. Skein of mercerized and dyed 2-ply yarn for hand embroidery. Marked "No. 3" 100 yards put up in regular skeins of 54 inches perimeter.
13. A skein of mercerized and dyed 2-ply yarn for hand embroidery. 22 yards put up in skein of 36 inches perimeter.

Novelty Yarn. Examine a piece of ratine. Note the knots in the yarn. Many novelty fabrics, particularly fabrics for ladies' wear, are made from unusual and freak yarns called *novelty* yarns. These fabrics are expensive to produce because they require special twisting machines for taking single yarns and twisting them into two ply or more, with a device for producing a loop in the yarn as it is being twisted.

There are five distinctive types of novelty yarn: spiral, spot, snarl, loop, and slub. There may be modifications of each and combinations of two or more. Every type of novelty yarn consists of two or more of the following members: A *base* or foundation end, around which the end or ends intended to create the effect or design are twisted; the *effect yarn*, the various characteristics of which constitute a design and give the threads their distinguishing titles; and the *tie yarn*, which is used to bind the effect thread in its correct position on the base and to prevent slip. Each of these may be single or ply yarn and may be grey or colored. The effect ends are formed from rovings, soft-twisted single yarn, or ply yarn, the last named in many cases being previously twisted in a fancy manner. In general, all of these yarns are made by twisting together at uniform but different speeds. *Spot*, *snarl*, and *loop* yarns are made by twisting two yarns together and varying the rate of delivery of one to give the effect. The various effects, as denoted by the names, are due to the relation of the two twists and to their character. In *spot* yarn the effect yarn winds closely around the

base in spots or at intervals. *Snarl* makes a twisted snarl at intervals, and *loop* gives a loop of yarn at intervals. *Slub* yarn is made by spinning or twisting roving with ordinary yarn or yarns at intervals, or making it continuous and bunching it at intervals.

Thread. In general a twisted strand of cotton, flax, wool, silk, etc., spun out to considerable length, is called *thread*. In a specific sense, thread is a compound cord consisting of two or more yarns firmly united by twisting. Thread is used in some kinds of weaving, but its principal use is for sewing, for which purpose it is composed of either silk, cotton, or flax. Thread made of silk is technically known as sewing silk; that made of flax is known as linen thread; while cotton thread intended for sewing is commonly called spool cotton. These distinctions, while generally observed by trade, are not always maintained by the public.

Manufacturing Processes. The raw cotton for the manufacture of thread must be of long staple. If the fiber is short the thread made of it will be weak, and hence unsuited for the purposes required of it. Ordinary cotton is not adapted to the manufacture of the better grades of spool cotton on account of the shortness of its fiber. Egyptian and sea island cottons are used because they have a much longer fiber and are softer in texture. The raw cotton passes through the picker machine, carding, combing, drawing, and mule frames. Having passed through the complex processes of cleansing, combing, drawing, and spinning, the cotton is now in the form of yarn of various sizes, and the real work of thread making, which is a distinct art from yarn making, begins.

The thread-making process is briefly as follows: The yarn is doubled and twisted; then three of such yarns are twisted together, which gives the sixfold combination for six-cord thread. For a three-cord thread three yarns are twisted together. After the

twisting is completed the thread is reeled into skeins having a continuous length of 4,000 to 12,000 yards, according to the size, and is then sent to the examining department, where it is rigidly inspected. Every strand is looked over, and those found to be defective are laid aside, so that when the thread is put on the market it shall be as perfect as care and skill can make it.

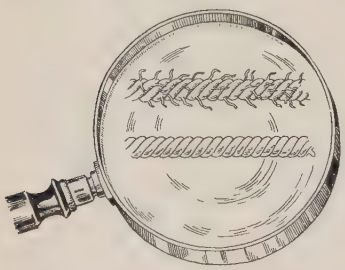
At this stage of the work the skeins of thread are of the pale cream color common to all unbleached cotton goods, and are technically known as "in the grey." They therefore have to be bleached pure white or dyed in fast colors.

From the bleaching and dyeing departments the skeins of thread go back to the mill to be wound on the bobbins, and from the bobbins finally on the small wooden spools. The automatic winding machines can be regulated to wind any given number of yards. The small spools are fastened on pivots, the thread from the bobbins fastened on the spools, and the machines set in motion. At the required number of yards the spools stop revolving. The ordinary spool of cotton thread contains 200 yards, and when this has been wound on, the thread is cut with a knife by an attendant, who also cuts the little nick in the rim of the spool and fastens therein the end of the thread. Thread mills commonly print their own labels, and these are affixed to the spools by special machinery with remarkable rapidity. From the labeling machine the spools go to an inspector, who examines each one for imperfections, and any that are found faulty are discarded. When packed in pasteboard boxes or in cabinets the thread is ready for market.

Thread Numbers. Spool cotton for ordinary use is made in sizes ranging from No. 8 coarse to No. 200 fine. In cotton yarn numbering, the fineness of the spun strand is denoted by the number of hanks, each containing 840 yards, which are required to weigh one pound, as illustrated in the following table:

When	1	hank of cotton yarn	(	840 yds.)	weigh	1	lb.	it is	No.	1
"	10	" " "	"	(8,400 yds.)	"	"	"	"	10
"	16	" " "	"	(13,440 yds.)	"	"	"	"	16
"	30	" " "	"	(25,200 yds.)	"	"	"	"	30
"	50	" " "	"	(42,000 yds.)	"	"	"	"	50
"	100	" " "	"	(84,000 yds.)	"	"	"	"	100

The early manufactured thread was three cord, and took its number from the size of the yarn from which it was made. No. 60 yarn made No. 60 thread, though in point of fact the actual caliber of No. 60 thread would equal No. 20 yarn, being three No. 60 strands combined. When the sewing machine came into the market as the great consumer of thread, spool cotton had to be made a smoother and more even product than had previously been necessary for hand needles. This was accomplished by using six strands instead of three, the yarns being twice as fine. As thread numbers were already established, they were not altered for the new article, and consequently at the present time No. 60 six-cord, for example, and No. 60 three-cord are identical in size, though in reality No. 60 six-cord is formed of No. 120 yarns. It is relatively smoother, more even, and stronger than the three-cord grade. All sizes of six-cord threads are made of six strands, each of the latter being twice as fine as the number of the thread designated by the label. Three-



SHOWING UNCOMBED AND COMBED 6-CORD SPOOL COTTON MAGNIFIED

cord spool cotton is made of three strands of yarn, each the same number as the thread.

Lisle Thread (*Lille thread*). Originally, a fine, hard-twisted linen thread made at Lille (formerly called Lisle) in France, used in the manufacture of stockings and gloves. At present lisle thread is spun almost exclusively from long-stapled Egyptian cotton. The raw cotton is prepared for spinning by carding and combing. By the combing process a stronger, smoother, and more glossy yarn can be produced. Lisle yarn is usually spun and twisted in a moist atmosphere, thus intensifying its compactness and solidity, and not infrequently it is gassed (passed over a hot plate) to remove the ooze and give it a smooth, clean surface. Glossed lisle yarn is produced by the calendering process, which gives it a brilliant, lustrous finish. An especially brilliant finish is sometimes produced by treating it with tallow after dyeing. Tallow not only imparts a beautiful luster, but it also serves to strengthen the effect of the colors and gives the yarn a soft and silky feel.

Garments knitted of lisle thread have a dry, cool feeling, and do not become soggy from perspiration as do those made from the more loosely twisted carded yarns. Each fiber of the combed thread retains its separateness, and there is no felting; consequently, the smooth threads slide and slip in their meshes and thus give great elasticity to the whole garment, peculiarly adapting them to the production of high-grade underwear, gloves, and hose.

QUESTIONS

1. What are the principal changes that are wrought in a bale of cotton: (*a*) In the picker room; (*b*) in the carding machine; (*c*) in the process of combing?

2. Describe both the drawing frame and the fly frame.

3. (*a*) What is spinning?

(*b*) What are the objects of the spinning process?

4. Give a detailed explanation of mule spinning and contrast it with ring spinning.

5. How is cotton bought and sold? Where are the quotations given?

6. What is combed cotton yarn? How is it sold? What are its uses?

7. Define the following terms: Card clothing; cotton sliver; cotton noils; roving.

8. (*a*) How is cotton bought and sold?

(*b*) If cotton falls 10 points on the market, how much per lb. has the cotton fallen in price?

9. What determines the price of cotton?

10. Why is there difference in price between northern and southern mills cotton for the same grade of yarn?

11. How is yarn bought and sold?

12. Explain the difference in selling cotton in: skeins; beams; cones; cops; tubes; bobbins.

13. Explain the difference between warp and filling yarn.

14. State the difference between single and double or ply yarn.

15. (*a*) How is the fineness of cotton yarn expressed?

(*b*) How many yards are there in one lb. of 2/30's cotton yarn?

16. State the differences in uses of cotton yarn.

17. Describe the different colors and finishes of cotton yarn.

18. What are the distinct types of novelty yarns?

19. State the general characteristics common to all these types.

20. (*a*) Classify novelty yarn goods.

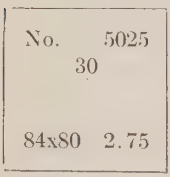
(*b*) Describe the manufacture of each.

21. (*a*) Define the word thread.
    (*b*) State its use.
    (*c*) Of what is thread made?
22. Explain briefly the thread-making process.
23. Show by examples how thread is numbered.
24. Describe the manufacture of lisle yarn or thread.
25. What are the properties and uses of this yarn?

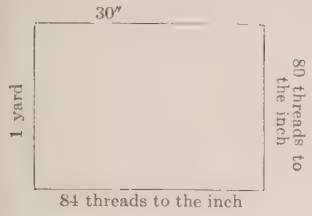
CHAPTER XIV

COTTON FINISHING

Grey Cloth. Cotton goods may be considered, broadly speaking, as either: (*a*) *manufactured cotton goods*, as gingham, or (*b*) *a converted fabric*, as lining. A manufactured fabric is one that is really made ready for use on the loom, as a gingham or a drill. The converted fabric, like a lining, is made on the loom as a piece of "grey goods" and may be converted later into a lining or some other fabric by special methods of finishing. Most mills weave the cloth in the grey and then sell it. The price of the cloth varies from day to day, and quotations are furnished in the papers. The quotation furnishes with the price the three principal specifications: width, construction, and weight. The width is the breadth of the cloth and is expressed in inches. The construction is represented by the number of threads to the inch in the warp and the number of threads in the filling: thus, 84 x 80 means 84 warp threads or ends to the inch and 80 filling threads or picks to the inch. The weight of the fabric is expressed in two ways: by the number of ounces to the yard, as 3 oz., or the number of yards to the pound, 2.75 meaning 2.75 yards to the pound. This is shown in the figure above.



The size of the yarn may be easily determined from the above specifications as follows: 30″, 84 x 80, 3 oz.



(1) Take 1 yard of cloth.
(2) Find number of yards in warp.
(3) Find number of yards in filling.
(4) Total yards of yarn in 1 lb.
(5) Divide by 840 to find the size of yarn.

The description, 84 threads to the inch in warp and 30″ wide means the cloth is 36″ or one yard long; $\frac{36}{36}$ x 84 x 30 yards of warp yarn.

$$\frac{80 \times 36 \times 30}{36} = \text{yards of filling yarn.}$$

84 x 30 x 80 x 30 = yards of warp and filling yarn in one yard. Since the yarn bends in weaving, we must increase the length by 10% to make allowance for this "take up."

$$30(84 + 80) = 164 \times 30 = 4920 \text{ yards}$$
$$492 \ 10\%$$
$$5412 \text{ yards}$$

5412 yards weighs 3 oz.
$1804 \times 16 = 28864$ yards to the pound

$$\frac{28864}{840} = 34\text{–}\tfrac{1}{2} \text{ or } 34\text{'s approx. size of the yarn}$$

Examine a piece of grey cotton goods and note the color, softness, lack of body, etc. Since cotton has a yellowish color and lacks the properties that make a fabric attractive to the eye, it is usually necessary to

finish the cotton fabric after it leaves the looms before it will appeal to the consumer.

The following represent an idea of quotations on grey goods:

Dec. 10, 1921 ..... N. Y. Spot Cotton, 18.20

	Second hands	Southern spot and nearby	Southern contracts	Eastern spot	Eastern cont
PRINT CLOTHS					
25 -inch, 56x44, 10.55	..	..	..	4¼	..
27 -inch, 44x44, 9.50	..	..	..	4½	..
27 -inch, 56x52, 9.00	..	..	..	4 13–16	..
27 -inch, 64x60, 7.60	..	5¾	5¾	..	..
31½-inch, 48x48, 8.70	..	..	..	5	..
31½-inch, 56x52, 7.50	..	..	..	5⅞	..
32 -inch, 60x60, 6.50	..	6¾	..	6⅝	..
36 -inch, 40x40, 9.20	..	..	..	4¾	..
36 -inch, 48x44, 7.75	..	..	..	5¾	..
38½-inch, 44x40, 8.20	..	..	..	5⅞ ask	..
38½-inch, 48x48, 7.15	..	..	..	6¾	..
39 -inch, 56x44, 6.60	..	6¾	..	6¾	..
38½-inch, 60x48, 6.25	..	7½	7½	7¾	..
38½-inch, 60x52, 6.00	..	..	..	7⅞	..
38½-inch, 64x56, 5.50	..	8½ ask	..	8½	..
38½-inch, 64x60, 5.35	..	8⅝B	8¾	9 ask	..
39 -inch, 68x72, 4.75	..	9⅝	9¾	..	..
39 -inch, 72x76, 4.25	..	10½	10½	..	..
39 -inch, 80x80, 4.00	..	12¼–12½	..	..	..
39 -inch, 80x88, 5.00	..	14	..	14½	..
39 -inch, 96x92, 5.25	..	..	..	17½	..
39 -inch, 88x92, 5.00	..	..	..	16½	..
39 -inch, 96x100, 5.00	..	..	..	17	..
39 -inch, 96x100, 4.15	..	..	..	16½	..
44 -inch, 48x48, 6.40	..	..	..	7	..
44 -inch, 44x40, 7.25	..	..	..	6¼	..
SHEETINGS					
31 -inch, 48x48, 5.00	..	7–7⅛	..	..	..
32 -inch, 40x40, 6.25	..	6	..	..	..
36 -inch, 44x40, 6.15	..	6½	..	..	..
36 -inch, 48x40, 5.50	..	7¼	..	..	..
36 -inch, 48x48, 5.00	..	8	8 terms	..	..
36 -inch, 48x52, 4.70	..	8½	8½ terms	..	..
36 -inch, 56x60, 4.00	..	9⅝ net	..	..	..
36 -inch, 48x52, 4.00	..	9½ terms	..	..	..
37 -inch, 48x48, 4.00	..	9	9	..	..
36 -inch, 48x48, 3.00	..	10–10½	..	..	..

36	-inch, 64x68, 3.50	11	
36	-inch, 48x44, 3.25	10 terms	
40	-inch, 48x44, 3.75	9¼–9¾	
40	-inch, 44x40, 4.25	8¾	
40	-inch, 56x60, 3.60	11–10¾	
40	-inch, 64x68, 3.15	12½	
40	-inch, 48x48, 2.85	11 11	
40	-inch, 48x48, 2.50	12¾	
40	-inch, 44x44, 5.00	8¼	
40	-inch, 44x44, 5.50	7¾	

The quotations continue, with prices for pajama checks, three-leaf twills, pocketing twills, onasburgs, drills, organdies, pongees, voiles, combed lawns, carded lawns, poplins, sateens, silks, cottons, etc.

Cotton Finishing. Cotton fabrics, like other textiles, must be subjected to various finishing processes to bring them into commercial condition. On piece-dyed goods part of the finishing is done before and part after the dyeing process. Each class of fabric has definite finishing processes. The finishing of cotton goods is in a large measure a *physical* or *mechanical* process. In its broadest sense, cotton finishing covers the fields of bleaching, dyeing, printing, mercerizing, starching, etc. The exact finishing operations depend upon the structure of the fabric and the use for which it is intended. The various processes are usually separated as follows:

1. Rendering the surface of the fabric clear: by shearing and singeing machines.

2. Rendering the surface of the fabric wooly: by raising and napping machines.

3. Loosening the threads, at the same time softening and filling the material: by steaming, shrinking, moistening, and dipping in hygroscopic substances.

4. Widening and lengthening the fabrics: by tentering and stretching machines.

5. Producing brilliant, glazed, sateen effects: by cylinders, calenders, mangles, beetling machines, etc.

6. Thickening or giving body to the material: by passing through a bath containing gumming, sizing, or starching material.

The principal finishing operations are: gassing, mercerizing, sizing, calendering, schreinerizing, dyeing, and printing.

After the cloth leaves the loom it is brushed; then it passes over to the inspection table in an upward receding direction, so that the operator can readily detect and remedy imperfections. These operations are called inspecting, burling, and trimming. The ends of two or more pieces as they come from the loom are sewed together for convenient handling in the bleaching.

Bleaching. The object of bleaching is to free the cotton from its natural color. The ancient method of bleaching by exposure to the action of the sun's rays and frequent wetting has been superseded by a more complicated process involving the use of various chemicals. Pieces of cloth are tacked together (sewed) to form one continuous piece of from three to one thousand yards in length. The cloth is next passed over hot cylinders, or a row of small gas jets, to remove all the fine, loose down from the surface. The goods are then washed and allowed to remain in a wet condition for a few hours, after which they are passed through milk of lime under heavy pressure, followed by rinsing in clear

water. No effect is produced by the lime. The goods are next "scoured" in water acidulated with hydrochloric acid, and boiled in a solution of soda, then washed as before in clear water. Next they are chlorined by being laid in a stone cistern containing a solution of chloride of lime and allowed to remain a few hours. This operation requires great care in the preparation of the chloride of lime, for if the smallest particle of undissolved bleaching powder is allowed to come in contact with and remain upon the cloth it is liable to produce holes. The goods are then boiled for four or five hours in a solution of carbonate of soda, after which they are washed. This operation produces a slight bleach. They are again chlorined as before and washed. The long strips are finally scoured in hydrochloric acid, washed, and well squeezed between metal rollers covered with cloth. The acid liberates the chlorine from the bleaching powder and bleaches the fabric white. After squeezing and drying, the cloth, if required for printing, needs no further operation, but if intended to be marketed in a white state, it must be finished, that is, starched and pressed. If sizing is to be added to the cloth, it is done after bleaching and drying.

Gassing. Various attempts have been made to increase the luster of cotton yarn and thereby increase the luster of the cloth. The principal methods are called *gassing* and *mercerizing*.

The object of gassing or singeing is the removal of the fuzz of loose projecting fibers found on all cotton yarns after ordinary spinning and doubling. The clearing

away of this fuzz from the surface of the yarn greatly improves its appearance, as the yarn shows up smoother, rounder, and brighter. An incidental but important result is that the yarn, by reason of the removal of the fuzz, weighs less per yard, and is therefore raised to a higher count. Incidentally, also, gassing slightly increases the relative strength of the yarn and makes it somewhat darker in shade. Gassing was used as early as 1835.

In gassing, the yarn is passed one or more times through the blue part of the flame from a Bunsen gas burner, the speed being regulated so that the projecting fibers are singed off without the yarn itself catching fire. Fine yarns are passed through a shorter length of flame and at a higher rate of speed than are coarse yarns. It is, however, not feasible to increase the speed in proportion to the yarn count; that is to say, the speed for 80/2 on the gassing frame would at the most not be more than 50 per cent above that for 20/2 though it is four times as fine. The finer the yarn, therefore, the longer it takes to gas a given weight, and the greater the cost per pound of gassing. The cost of the process also depends on the nature of the yarn, whether soft or hard spun, and on the degree to which the process is carried; voile yarns, for instance, are gassed severely, sometimes gassed twice, with necessary increase in cost. In some instances yarn is now gassed electrically, a charged plate being substituted for the gas flame as a singeing agent, but this system is still in course of development and has not come into general use.

In 1914 lace, as a consumer of gassed yarns, was followed in order by hosiery, broad silks, hatbands, velvet, cotton cloth, and sewings; in 1918 it was followed by broad silks, voile, hosiery, hatbands, velvet, and embroidery. An analysis of the uses of gassed yarns shows that normally about one half consists of hard-twisted yarns for direct use in making such articles as lace, voile, and labels, and about one half of soft twists, of varying degrees, for mercerizing. Most of the yarns are two ply from 40's to 80's. In the United States gassed yarns are usually sold at a price enough higher than plain to cover fully the cost of gassing. Finishing companies report the ordinary commission for gassing at from eight to fifteen cents per pound. Gassing is done by comparatively few American firms, and those that do it rarely have orders for counts above 80's.

Mercerizing. Commercial mercerization is a recent development and one of increasing importance. The history of the mercerization process dates back to 1850, when John Mercer, an English calico printer, patented a process for increasing the strength and solidity of cotton fabrics by subjecting them to strong solutions of caustic alkalies. It was not until 1890, however, when Arthur Lowe patented an arrangement for carrying out the process under tension, thereby obtaining a lustrous finish resembling silk, that the commercial importance of mercerization was recognized. The extensive development of the process has largely occurred since 1900.

Caustic soda is the alkali generally employed in

commercial mercerization. The object of mercerization is to obtain a lustrous silklike finish; incidentally the yarn is increased in strength and in affinity for dyestuffs. The caustic soda appears to be absorbed by the cotton fiber, which swells and thereby straightens out from its normal twisted-ribbon form. If the tendency to contract in length is prevented, the fiber assumes an appearance more cylindrical and hairlike. The smoother and more cylindrical the shape, the better light reflector, and therefore the more lustrous it becomes.

The mercerizing action of caustic soda is very rapid, in fact, 10 minutes is usually amply sufficient for the process; the alkali must then be rinsed out to prevent tendering. The production of a high degree of luster depends to a considerable extent on the fineness and length of the fiber. Sea Island and Egyptian cottons mercerize the best; other long staple cottons, including American Peelers, are the next best. The shorter stapled cottons, such as American uplands, were formerly considered unfit for mercerization, but the process is being perfected to such an extent that they can be used also, though the luster obtainable is not so pronounced as in the case of longer cottons. The best luster is obtained by the twofold twisting of long staple cotton yarns, in which the outer fibers lie as nearly as possible parallel to the axis, and by the removal of all projecting fibers by careful singeing (gassing).

Cotton yarn is mercerized either in the skein or in the warp; the former process is the older, and is still customary abroad, whereas the latter has become the

customary process in this country, as it is cheaper, and uniform results are more easily obtained. In skein mercerization the hanks of yarn are stretched around revolving rollers and successively subjected to the action of caustic soda, a washing with warm water, and, finally, a washing with cold water. When yarn is mercerized in the warp, it is passed continuously through a series of vats in which it is boiled out, treated with caustic soda, washed, treated with dilute acid, and finally finished with soap. The necessary tension is obtained by a series of squeeze rolls.

Yarns and fabrics constructed of the ordinary grades of cotton cannot be mercerized to advantage. The cost of producing high-grade mercerized yarn is about three times that of an unmercerized yarn of the same count, spun from the commoner qualities of cotton.

Mercerized yarn is employed in almost every conceivable manner, not only in the manufacture of half-silk and half-wool fabrics, and in lustrous all-cotton tissues, but also in the production of figures and stripes of cotton goods having non-lustrous grounds. Mercerized yarn used in connection with silk is difficult to detect except by an expert eye.

Gassed mercerized yarns are more lustrous than plain mercerized. The gassing process can either precede or follow the mercerization. These yarns are mostly mule spun Egyptian, the Egyptian cotton taking mercerization exceptionally well. Mercerization usually takes place in the grey, and any bleaching or dyeing is done afterwards.

The knitting industry is normally the main industry requiring mercerized yarns from abroad. It may be stated, incidentally, that in the knitting industry artificial silk has displaced large amounts of mercerized cotton yarn and that in years of low prices, silk is also a factor to be reckoned with. In 1914, broad silks, embroidery, and sewings (yarn for making sewing thread) were the main goods, after hosiery, into which imported mercerized cotton yarns entered. In 1918, broad silks were the only other goods requiring any substantial amounts of foreign mercerized yarns. The broad silks into which mercerized yarns enter are largely cheap goods for neckties and other purposes; for these the all-silk effect can only be attained by mercerizing cotton yarns to give a luster that will compare favorably with the silk with which they are interwoven. Certain manufacturers prefer foreign to domestic mercerization for this purpose. Reports from finishing companies show that the ordinary commission charges (these include a profit, of course) for mercerizing cotton yarns of 80's and under, are about 10 to 14 cents per pound.

Napping. Napping is an additional process which may be applied as a finish to any medium- or heavy-weight cloth. The cloth is passed through a special machine, called a napping or raising machine, and subjected to the action of wire-covered rollers which scratch the surface and brush up portions of the fiber so as to cause it to stand out and more or less hide the interlacing of the warp and filling. The napping is

facilitated by the use of specially soft twist filling yarns. The twill weave is best for this purpose, as it permits long regular floats which present an excellent surface from which to raise a nap.

A napped fabric, made by scratching the surface of the cloth so as to form a fibrous covering similar to that on the surface of flannel, is distinctly different from a cut-pile fabric, in which the pile is formed by extra threads which are cut so as to show projecting ends.

Finishing has not yet been, and probably never will be, reduced to an exact science. There are many more formulas for finishing and kinds of finishes than there are kinds of fabrics. This is not only due to the different uses to which the same fabrics are put, but it is also due in many cases to the customer having been educated to believe in a certain finish. With the same fabric one customer will prefer a piece of goods with one finish and another with another finish. Frequently by flattening threads, filling up interstices, and adding stiffening material, loose fabrics are made to appear firm and solid. In some instances, by the aid of such treatment goods are made to appear better than they really are. This is especially true as regards the heavily filled goods put out by the English finishers for export to the Orient and South American countries. In many cases such treatment is necessary in order to produce fabrics that are cheap enough to meet the demands of the trade. The cheaper grades of window hollands and bag goods are examples of this.

Finishing nevertheless calls for a knowledge of the material used. Without such knowledge the process can be expected to continue successfully only so long as the conditions remain normal. Under such circumstances an unexpected variation in the material might readily cause the breakdown of the process. In many cases faults in the finished goods can be traced directly to an insufficient knowledge of the material used. Frequently this is brought about by putting in the same mixing materials

incapable of reacting with each other. It is the aim of every finisher to produce uniform results. It is not easy, however, to produce results that are unvarying.

Starch dressing imparts to a fabric a stiffness and grip which improve and complete it. The finishing process also improves the appearance of the fabric, making it more salable and at the same time better enabling it to withstand shop wear.

Sizing Compounds. To a buyer, a finish should show off the real quality of the goods. Finishing is really a process of beautifying and improving. Sometimes it is done by mechanical treatment alone, but in most instances it is done in conjunction with such materials as are suitable for developing smoothness and gloss. The degree of luster obtained depends upon: (1) The material of which the calender rolls are made; (2) the pressure to which the fabric is subjected; (3) the amount of friction between the rolls; (4) the constituents of the dressing with which the fabric has been treated.

The materials used for starch dressing are usually divided as follows:

1. Stiffening and binding materials. These include such starches as corn, potato, wheat, rice, tapioca, casava, sago, and other specially prepared starches; also flour, dextrine, Irish moss, gums, glue, magnesium sulphate, sodium sulphate, etc.

2. Filling material. China clay, talc, blanc fixe, alum, etc.

3. Softening or conditioning agents. Tallow, soap, glycerine, cocoanut oil, soluble oil, stearine, waxes, etc.

4. Antiseptics. Carbolic acid, boric acid, salicylic acid, chloride of zinc, formaldehyde, etc.

5. Blueing materials. Aniline dyes, Prussian blue, smalt blue, ultramarine.

To summarize: All sizing is composed of the following parts: (1) A stiffening substance; (2) a softening agent; (3) a weighting compound; (4) a deliquescent substance; and (5) an antiseptic.

The stiffening agent is some form of starch, such as potato, arrowroot, sago, wheat, etc. Since the starch added to the cloth makes it very stiff, in fact, too stiff to be serviceable, another substance in the form of an oil, fat, or wax, called a softener, is added to the starch.

Some fabrics have a low construction and must have a substance added to increase the weight and fill the openings in the fabric. Such a substance is called a weighting compound and is usually calcium sulphate, clay, etc. Frequently a small amount of magnesium chloride is added to the sizing to absorb moisture from the air, which increases the weight of the fabric and acts as a softener. Magnesium chloride and other salts have the property of absorbing moisture from the air and are called deliquescent substances. Sizing compounds frequently cause mildew on the cloth, due to the growth of a microscopic plant which feeds on the starch and cloth. In order to prevent such a growth a small percentage of an antiseptic is added, such as zinc chloride.

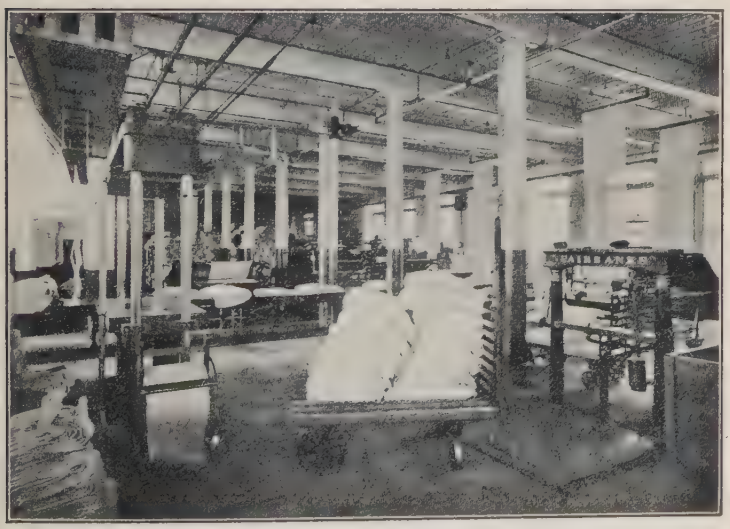
Warp Sizing. In order to make the yarns of the warp strong, so they will withstand the weaving without

chafing or breaking, it is necessary to coat the warp threads with a solution of starch and tallow, about 90% starch and 10% tallow. This process is done on a large machine called a *slasher*. The warp runs from one end of the machine, through the solution in a tank on the center, to the other end of the machine.

The object in sizing warp yarn before weaving is to enable that process to be performed with the minimum of threads breaking. Judicious sizing adds to the strength of the yarn by filling up the spaces between the fibers, and by binding the loose ends on the outside of the thread to the main part. In order to accomplish this a number of ingredients are used in the size preparation, as no single material used alone gives satisfactory results. The filling up of the minute spaces in the yarns and the adhesion of the fibers produce a smooth thread with sufficient hardness to resist the continual chafing of the shuttles, reeds, and harnesses during the process of weaving. Flour and starch in a liquid state are used for this purpose, but owing to the liability to mildew, flour is not so much used as starch. Both of these materials, however, make the yarn brittle, and other ingredients are combined with them to overcome the brittleness. For a softener on heavy-weight goods nothing has been found superior to good beef tallow.

Size Preparation. When properly made the size preparation is a smooth mass of uniform consistence, free from lumps of any kind, and from all sediment and odor. Starch — the principal material which gives body to any size — requires the most careful treatment.

It is first mixed with cold water into a smooth, creamy milk, which is slowly poured into the necessary quantity of boiling water until a clear, uniform paste is formed. Then the softeners are added, such as soaps, oils, and animal fats; next a small amount of gelatine or glue is stirred in and some form of preservative, usually



FINISHING ROOM

chloride of zinc or salicylic acid. The mass is then thoroughly stirred in tilted jacketed kettles with mechanical stirrers. The size may be applied to the yarn either hot or cold. When applied hot it penetrates into the interior, filling up every space between the fibers, binding all together, and forming a hard coating on the surface of the thread. A thorough washing or steaming serves to remove all the size from the woven fabric.

The starch is applied to the cloth by means of rollers which dip into a vat containing the solution, while other rollers remove the excess. Sometimes the cloth is artificially weighted with fine clay or gypsum, the object being to render the cloth solid in appearance.

Sizing. The operation of sizing is also often resorted to in finishing certain classes of cotton and linen fabrics, which are sized or dressed with various mixtures in order to create an appearance of weight and strength where these qualities do not exist, or, if present, only in a small degree. Each class of fabrics has definite finishing processes. In some cases weighting materials are added to the fabric so as to hide more or less its actual construction. Cotton fabrics just from the loom present a soft and open structure, more so than other textiles. Hence it is necessary to use proper finishing materials and processes which will fill up the openings or interstices produced in the fabric by the interlacing of warp and filling, and at the same time give to the fabric a certain amount of stiffness. Of course, this finish will disappear during wear or washing, it having been imparted to the fabric to bring the latter into a salable condition.

Starching Clothes. When a fabric is washed, particularly cotton (fancies), it is very desirable to know how to launder so that after ironing it the fabric will have the same appearance as when new. In the chapter on cotton finishing we saw that the degree of pliability, stiffness, and gloss is due to the sizing, especially the starches. There are many varieties of starch, such as

corn, wheat, rice, and blended starches. These blended starches are combinations of two or of all the others, with perhaps some borax and paraffin included. This is usually what the purchaser gets when she asks for "laundry starch." The quality of starch which adapts it for use as a dressing is its viscosity; in other words, its stickiness or tenacity. Of the three starches, corn has the greatest viscosity. Wheat starch has less viscosity, but more pliability, and rice has the least viscosity.

Thick starch is used for uniforms, collars, and cuffs. A medium starch is used for lingerie. A light starch is used for curtains and very fine pieces. Borax, alum, and paraffin will improve the starch so that a better color, gloss, and pliability will be obtained on the fabric. Tints may be obtained by the addition of blueing or other dyestuffs. Gum arabic and dextrine are very good substitutes for starch, especially for delicate fabrics such as organdies.

Calendering. Cloth is put through the calendering machine to give it a perfectly smooth and even surface, and sometimes a superficial glaze; the common domestic smoothing iron may be regarded as a form of a calendering utensil. The cloth is first passed between the cylinders of a machine two, three, or four times, according to the finish desired. The calender finishes may be classed as dull, luster, glazed, watered or moiré, and embossed. The calender always flattens and imparts a luster to the cloth passed through it. With considerable pressure between smooth rollers a soft, silky

luster is given by equal flattening of all the threads. By passing two folds of the cloth at the same time between the rollers, the threads of one make an impression upon the other, and give a wiry appearance. The iron rollers are sometimes made hollow for the purpose of admitting steam or gas in order to give a glaze finish. Embossing is produced by passing the cloth under heated metal rollers upon which are engraved suitable patterns, the effect of which is the reproduction of the pattern upon the surface of the cloth.

Schreinerizing. The natural luster of the mercerized sateen weave is often enhanced by a process similar to that used in finishing venetians. The most usual of these is the milling or *schreiner* process. This process subjects the cloth to the action of a steel roller engraved with very fine lines. This has a tendency to flatten the threads composing the fabric and impresses the surface of the cloth with a close series of ridges so fine that a magnifying glass is needed to distinguish them. These lines reflect the light and give a high luster.

Cotton Mold. Cotton fabrics are frequently spoiled and weakened (made tender) by a very small vegetable plant called a mold. This little plant floats through the air or is carried by drafts, and alights on pieces of cloth or on the starch or gelatine used.

The development and spreading of cotton mold (or fungi) can be caused in a variety of ways, the most important ones being: The use of inferior materials (sour or too watery starch or gelatine) in bleaching or finishing and the storing of goods treated with such materials in damp, warm or dark places (careless storing is apt to

develop trouble); improper washing and scouring of cotton in polluted water; carelessness in handling cotton by leaving it in a damp, warm place for some time. Metallic salts (copper sulphate, zinc sulphate), chlorine, sulphur dioxide and especially boric acid, are used as antiseptics or disinfectants in case of molds.

Fireproofing. Cotton fabrics, especially the napped cloths, are very inflammable. Various attempts have been made to make them fireproof.

A process for rendering fireproof fabrics, especially cheaper grades of flannelettes, was invented a few years ago by W. H. Perkin, of Oxford University. This process of permanent fireproofing consists in treating the fabric in a solution of sodium stannate of 45 degrees Twaddell. After thorough drying the fabric is treated with a solution of ammonium sulphate of about 15 degrees Tw. A later process, patented by Perkin and Samuel Bradbury, of Manchester, England, in 1917, has the nap raised (wherever it is called for) and the starch entirely removed and then treated with sodium aluminate at 30 degrees Tw. The fabric is then squeezed out and dried and treated with carbonic acid gas and steam.

Waterproofing. While millions of yards of fabrics are sold every year as "waterproofed," there are few if any that are completely satisfactory.

This is due to the fact that the waterproof fabric should resist the passage of water and of air and at the same time allow for ventilation, that is, allow the passing of air through the pores of the fabric. There are various methods of waterproofing:

(1) Adding a mixture of a drying oil to the fabric, as rum and linseed oils. An objection in addition to non-permeability to air is that such fabrics are liable to crack.

(2) The addition of aluminum soaps is the most satisfactory method.

Converting Terms. In addition to the above finishing processes which are general in character, there are certain trade terms used to describe specific styles or types of finishes such as *plisse*, *chasing*, *glazing*, *frosting*, *beetling*, *permanent finish*, *dull*, *improved*, *special*, *pure*, *plain*, *waxing*, *shrunk*, *de luxe*, *wool finish*, *linen finish*, *silk finish*, *mottled*, *back filling*, *spun glass*, *embossed*, *moiré*, *two side*, *zinc print*, *full bleach*, *half bleach*, *full mercerizing*, *blotch printing*, *blue white*, and *duplex*.

Plisse is a crinkled (crêpe) effect on cotton cloths and resembles seersucker. It is produced by placing a resist gum on every part of the fabric that is not to show this finish. Then the fabric is immersed in a caustic soda bath which shrinks the part of the fabric that does not contain the resist. This is not a permanent finish as ironing will destroy the effect.

Chasing is a form of moiré finish produced by pressing two ends of cloth over each other in a hot calendering operation. The pressure on the cloth gives a thread structure and luster to the fabric. This finish is not permanent, but like many of the finishes is placed on the fabric to make it attractive to the buyer.

Glazing is a high polish or luster produced by sizing with a composition of starch, wax, and gum, and then pressing by friction on a hot calender. This finish is not permanent.

Frosting is a slight luster produced by schreinerizing with low pressure.

Beetling is a process which gives a slight moiré effect and is produced by holding the cloth on rollers with hammer blows. This finish is given to some cotton taffetas and linings. The blows of the hammers cause the great number of thread structures to be imprinted on the fabric. This finish is not permanent.

Permanent finish is a very crisp finish with elasticity given to a fabric like organdie. The action of the finishing agents is more chemical than physical and changes the characteristics of the cotton. This finish is permanent and can be restored after washing.

Dull finish is produced on a fabric with or without tentering

and then followed with a very slight heated calendering. This finish is put on some cambrics which are used for linings of suitings.

Mottled finish is produced by dyeing an unbleached fabric. The unbleached condition causes uneven dyeing, and the fabric has an appearance resembling chambray color effect.

Back filling finish is given to cotton fabrics of low construction so as to make them appear solid and of higher construction. This finish is produced by adding a sizing, such as clay, that fills the openings between the threads. Some window shades are treated in this way.

Spun glass finish is a high luster given to fabrics by a roller etched with fine straight lines. This finish may be distinguished from schreinerizing by examining closely with a magnifying glass. The lines produced by schreinerizing are diagonal and not straight. This finish is not permanent and is used for draperies.

Embossed finish is due to impressions made by rollers engraved with floral designs on dyed fabrics to give the impression of a Jacquard design fabric.

Napping finish may be single, double (two sides), slight, or heavy, depending upon the extent of the napping operation.

Zinc print finish means that a design is printed on the dyed ground fabric by printing from an etched roller made of zinc.

De Luxe finish is a very high luster produced by schreinerizing with a roller of 360 cuts or lines to the inch. This is the highest luster that can be given to cotton-fabric Venetian.

Full bleach finish means that the cotton fabric has received one boiling in alkali and one boiling in bleaching powder.

Half bleach finish means a lighter bleach than full and is obtained from one boiling in alkali.

Full or double mercerizing finish means that the fabric has received the maximum mercerizing effect by immersion in 23% cold caustic soda.

Semi- or half-mercerizing finish means that the fabric has been mercerized in a weak solution of alkali.

Felting finish is produced by napping, brushing, and pressing operations, which makes the fabric look like felt.

Blue white finish is produced by the addition of a small quantity

of bluing to the bleached cloth to neutralize the yellowish effect produced by long storage.

Blotch printing finish means that the surface of the cloth outside of the design is printed in one color. This is done to give the impression that the printing is done on a dyed ground by the extract or resist method.

Duplex finish is applied to a cotton fabric by printing on both sides.

Improved finish is a very high luster produced on a fabric by additional sizing and calendering the fabric several times.

Special finishes are usually secret processes of the finishing operations described above. For example, soft finishes are improved by the addition of considerable glycerine, fats, oils, and waxes in the sizing. Gloss may be improved by the addition of mucilage, gums, etc.

Pure finish is one given to a fabric by a sizing of pure starch without clay or other filling. The object of this finish is to make the fabric cut very easily — preserve cutting knives — as nainsook, cambric, lawn, and batiste.

Plain finish is an unmercerized fabric.

Waxing finish is a special glaze made by the use of starches, waxes, gums, and then pressed by friction over hot calenders. This finish is given to linens and automobile tires.

Shrunk finish is one that reduces the width of a cloth. For example, a cloth reduced from 36″/38″ to 30″/31″.

Woolen finish is given to make cotton fabrics look like wool. The cloth is not singed but is slightly napped.

Linen finish is one that makes cotton look like linen by treatment with special sizing and then pressing with calender rollers to make the threads flat so as to reflect the light.

Silk finish is produced by full mercerizing, gassing, and schreinerizing. The addition of Glauber's salt in the sizing will increase the luster and give the rustle effect, as in the case of taffeta. The addition of oil softeners will make the fabric soft, as in the treatment of cotton sateen, cotton charmeuse, and cotton messaline.

Characteristics of a Good Piece of Cotton Cloth. A perfect cotton fiber has little convolutions in it

which give the strong twist and spring to a good thread. In this respect the Sea Island cotton is the best. There are five things requisite for good cotton cloth, viz.:

1. The cloth must be made of good fiber, that is, ripe and long.

2. The fiber must be carefully prepared. All the processes must be well performed; for the very fine thread fiber must be combed to remove poor fiber. The combing, however, is not always done.

3. The warp and filling threads must be in good proportion.

4. The cloth must be soft, so that it will not crease easily.

5. It must be carefully bleached — the chemicals used must not be strong.

Selling Points of a Good Piece of Cotton Cloth.

Summarizing the qualities of cotton, we find that:

1. It is suitable for summer wear because it is cool to the touch, due to the fact that it is a non-conductor of heat.

2. It is reasonable in price and is very serviceable, as it can be easily and quickly washed.

3. Any degree of body or thickness may be given to it after washing and rinsing by the addition of sizing, starch, etc.

4. It only shrinks when it is loosely woven, due to the loss of sizing.

5. It crushes easily because it lacks natural body or stiffness.

6. In many cases it is not fast to bright colors, except when vat and sulphur colors are used.

7. It does not lose its shape, although it wrinkles, due to a lack of elasticity as compared with wool and silk.

QUESTIONS

1. (*a*) What is grey cloth?

(*b*) State the difference between " grey " cloth and " gray " cloth.

(*c*) How is grey cloth bought and sold?

2. What is the difference between a converted fabric and a manufactured fabric?

3. What are the principal specifications of a cotton fabric? Examine the following label and explain the meaning of each number.

No. 8175 36″ 64 x 60 375

4. (*a*) Is it possible to determine the size of yarn from the width, construction, and weight?

(*b*) Determine the size of yarn used in the following fabric: 36″ wide; 72 x 72; $3\frac{1}{2}$ oz.

5. Describe the characteristics of a piece of grey cloth.

6. (*a*) Name the principal finishing operations.

(*b*) State those that are chemical and those that are physical in character.

7. (*a*) Describe the process of bleaching.

(*b*) Does it weaken or strengthen a fabric?

8. (*a*) Explain the difference between gassing and mercerizing.

(*b*) State the value of each process.

9. Is it possible to mercerize cheap cotton yarn or cloth?

10. (*a*) What is cotton napping?

(*b*) What fabric can be napped to best advantage?

(*c*) Does it improve the cotton fabric?

11. (*a*) What is sizing?

(*b*) Give the principal components.

(*c*) State the value of each.

12. (*a*) Define the following terms: Antiseptic; softening compound.

(*b*) What is the difference between warp sizing and cloth sizing?

13. What is meant by: Light size; medium size; heavy size?

14. (*a*) What is schreinerizing?

(*b*) Describe the process and state the value.

15. What is calendering?

16. Give the characteristics of a good piece of cloth.

17. Explain the classes into which cotton goods may be divided.

18. What information does the cloth quotation furnish?

19. How may the luster of cotton cloth be increased?

20. On what does the degree of luster depend?

21. How is the sizing preparation made and applied?

CHAPTER XV

COTTON FABRICS[1]

Albatross. Cotton albatross cloth, used for house and children's dresses, kimonos, etc., is made in imitation of a worsted fabric of the same name. It has a fleecy surface. The name is taken from the bird whose downy breast the finish of the fabric resembles. The warp is usually 28's cotton, the filling 36's cotton. It is a plain weave. Filling and warp count 48 × 48 per inch. The goods are finished by being burled, sheared, washed, singed, dyed, rinsed, dried, and pressed, care being taken not to press too hard. Sometimes singeing is omitted. Albatross cloth is generally in white, black, or solid colors. It is not often printed. It is light in weight. On account of the unevenness of the surface of the fabric, due to the unevenness of the yarn, it catches dust and lint more than a smooth surface. The cloth is woven of soft spun yarn, which makes the fabric soft, and it therefore lacks the firmness necessary for tailoring.

Awning. A cotton cloth used as a cover to shelter from sun rays.

[1] This information is from the leading authority, "The Cotton Fabrics Glossary," published by the *American Wool and Cotton Reporter*, Boston, Mass., and is reproduced in part here through the kindness of Mr. Frank P. Bennett.

Batiste. Batiste is of French origin, and is a light, transparent cloth, made from a fine quality of combed cotton yarn. There is a gradual variation in quality ranging from a comparatively coarse to a very fine fabric. The variety of qualities will suggest some idea of the utility of the fabric. Its uses are even more varied than are the qualities. The finer grades are used for dress goods and all kinds of lingerie, etc., while the cheaper grades are used for linings. The finest grades are made of high-grade cotton yarn, usually 100's warp and 150's filling, and a construction of 100x98. The cheaper grades have a construction of 52x52, and use yarn of 60's in the warp and 100's in the filling. Batiste is woven in the grey, that is, with yarn direct from the spinning frame, with the exception that the warp yarn is well sized, in order to stand better the strain to which it is subjected during the weaving process.

Bedford Cord. This is one of the most popular types of fabrics, the distinguishing effect being a line or cord running lengthwise of the cloth, the cord being more or less prominent. It is used for dresses, skirts, and sport costumes. The cloth is made of cotton, or of worsted. The face effect of the Bedford cord is generally plain. Occasionally, twill-faced cords are used. The cords vary in width from about one twentieth to one quarter of an inch. To get extra weight without altering the appearance of the face, extra warp yarns, termed wadding ends, are inserted between the face weave and the filling, floating at the back of the rib. When these wadding ends are coarse, they give a pro-

nounced rounded appearance to the cord. The fabric is made of good cotton yarn, such as 40's warp and 60's filling. The yarn used for the cord is lighter — 20's or lower. Since the fabric is expected to be heavy, it has a very close construction, varying from 96x88 to 220x156.

Beige. Beige represents a class of dress goods with a distinct mottled or mixed effect, of cotton and wool. The best grades are made of wool and cotton, mixed in the raw condition. Some of the stock is dyed, while the rest is undyed, and it is spun in this condition, which gives a mottled appearance to the cloth. The cheaper grades are made by printing a cotton cloth on both sides to give it the mottled appearance. It is woven as a plain weave, with 28's warp and filling, and the construction is 60x48. It is finished with a light starching and pressing to give it a soft feel.

Bengaline. Cotton bengaline represents a class of cotton fabrics made as a substitute for the original silk fabric by that name. It is used for dress goods, skirtings, draperies, etc. It is a heavy fabric, similar to poplin, with cords running lengthwise or crosswise. It varies in quality from a mixture of silk and cotton to mercerized cotton. The fabric has a plain weave, with a finer yarn in the warp than in the filling, and has twice as many ends as picks. It may be yarn or piece dyed, has a construction of about 10x54, and may be made of 2 ply 60's warp and 35's filling.

Bengal Stripe. This term is used in describing a strong, durable fabric, similar to a gingham. The

colored warp yarns are dyed with a Bengal indigo, which makes it a very fast-color fabric. There are cheaper grades on the market, dyed with inferior colors. The fabric is made of low-count yarn, 9's warp and 16's filling, and has a construction of 64x48.

Bourrette. A light-weight, single-cloth fabric, used for ladies' fall suitings, with two-ply cotton warp and wool or a combination of cotton and shoddy filling, made with the plain weave, and in appearance a semi-rough-faced woolen fabric with fancy effects in twist scattered about it.

Buckram. Buckram is derived from Bokhara. It is a coarse, glue-sized fabric, made of cotton, hemp, linen, or cotton and hair (coarse) yarns, usually from 10's to 25's. It is made of a double cloth warp, 22's cotton, 34 picks to the inch, for the face or top fabric $\frac{1}{1\frac{1}{2}}$'s [1]; weight from loom 2.22 ozs. per yard. Bottom fabric $\frac{1}{1\frac{1}{2}}$'s cotton; filling $\frac{1}{1\frac{1}{6}}$'s cotton; 12 picks to the inch; weight per yard, 1.8 ounces. These fabrics depend a great deal on the finishing. The men's wear requires less sizing on account of the hair it contains. The goods are piece dyed. Buckram is used principally for stiffening garments, and to give them shape or form. It is placed between the lining and the surface cloth of the garment in particular parts, such as the lapels, etc. Millinery buckram is sized two or three times.

Calico takes its name from Calicut, a city in India, where cloth was first printed. The majority of inex-

[1] $\frac{1}{1\frac{1}{2}}$'s cotton signifies single cotton yarn of 12's. $\frac{2}{1\frac{1}{2}}$'s cotton signifies two sets of single cotton yarn of 12's twisted together.

pensive cotton fabrics are constructed on the one up, one down system, or plain weave. Calico is no exception to this rule. The printed designs on calicoes may be somewhat elaborate or they may be simple geometrical figures. New styles and combinations of colors are produced every month, and faster and lighter colors are printed each season. Most of the designs for calicoes and cotton cloth printing are made in Paris. At present the steam styles are most prominent; they are the fastest and lightest to be obtained. Calicoes are used for inexpensive dresses, shirtwaists, wrappers, etc. However, they are usually in two colors, that is, one color for ground and the other for figure. The ground color in most cases is effected by dyeing the cloth in some solid color. The cloth, after it comes from the loom, is singed and bleached, then sheared and brushed to take away all the lint, and then sent to the dye-house. The first process there is to boil it, after which it is immersed in the dye-tub. Calicoes are usually given what may be termed a "cheap cotton dye." By " cheap cotton dye " is meant that the colors are not fast, but will run or fade when subjected to water. After the fabric is dyed it is given to the printer, who ornaments the face of the cloth with some geometrical design. After printing, the cloth is dried and steamed to fix the color, afterwards soaped, washed, finished, and folded; then it is practically ready for the merchant. This fabric is of 30's yarn, with a construction of 66x52.

Cambric. Cambric is a heavy, glazed cotton fabric with a smooth finish. It was first made in Cambrai, France. It has a plain weave and a width of thirty-six inches. Cambrics are dyed in a jig machine. After dyeing they are run through a mangle containing the sizing substance, then dried, dampened, and run through a calender machine. The glossy effect is obtained in this last finishing process. Cambric is used for shirt-waists, dress goods, underwear, etc. The finer grades are made from hard-twisted cotton of good quality, or of linen. It is usually made with yarn of 28's or 30's.

Canvas. This is a term applied to heavy, plain weave cloths made with ply cotton yarn. They are used for mail bags, covering for boats, etc. The ply yarn, such as 6-ply warp and 9-ply filling, makes the fabric thick. Only low count yarns, about 14's, are used in the warp and filling.

Challis (*cotton*). This fabric is of medium weight cotton finished to resemble wool challis, and is used for comfortable coverings, kimonos, etc. It is usually a printed pattern, and is not a very expensive fabric.

Chambray. Chambray is a staple fabric of many years' standing, being next in rank among cotton goods after the better grade of gingham. Chambray is a light-weight single-cloth fabric that is always woven with a plain weave, and always has a white selvedge. In effect it is a cloth having but one color in the warp, and woven with a white filling, this combination producing a solid color effect, the white filling reducing

any harshness of warp color in the cloth. It wears well and is easily laundered. It is composed of one warp and one filling, either all cotton, cotton and silk, or all silk. This fabric is used for children's dresses, rompers, women's dresses, etc. It is 29 to 30 inches in width and of single 30's cotton warp to single 60's silk, the count of yarn being governed by the weight per yard desired. The construction is usually 72x56. The weight per finished yard is two to three and one-half ounces. Good colors for the warp are navy blue, dark brown, lavender, black, nile green, etc. When made of cotton warp and filling the fabric receives a regular gingham finish. The loom width can be restored by tentering or running the goods over a machine fitted underneath with a series of coils of steam pipe. The top of this machine is fitted with an endless chain with a row of steel needles standing erect upon its face. Chains are adjusted to the width desired, and as the machine runs, both selvedges are caught by the needles and the cloth stretched to the required width.

Cheese Cloth. This is a thin cotton fabric of light weight and low counts of yarn, which ranks among the cheapest cotton goods. It is used for innumerable purposes. The bleached fabric is used for wrapping cheese and butter after they are pressed. It is also much in demand for bunting for festival occasions, light curtains, masquerade dresses, etc. When used for bunting, draperies, and the like, it is usually in colors, red, blue, cream, and yellow seeming to have the greatest demand. The weave is one and one or

plain weave. The cloth is made of single yarn, 28's to 30's in the warp and 36's to 40's in filling. The construction varies from 20x12 to 48x44.

Cheviot. Cotton cheviot represents a class of cotton fabrics in imitation of the original wool fabric. It is used for workingmen's shirts. It is a strong, fairly heavy fabric, with stripe patterns, and is woven with a plain or twill weave and of coarse yarns from 16's to 22's. The yarn is dyed in fast colors, usually blue or brown. The construction varies from 40x36 to 62x52. The cloth is not finished except by sprinkling and pressing.

Chiné. A term sometimes applied to glacé silk, or cotton two-toned effects. The name is French, meaning woven so as to have a mottled effect.

Chintz. Printed cotton cloth, with large, many-colored designs, used for furniture covering. The Hindoo wears it as a body covering. Chintz is the Hindoo word meaning variegated.

Plain and Fancy Coutils. Coutil is a heavy, close-woven, smooth cloth, of medium coarse yarns, usually two ply in the best grades. The fabric is especially designed to withstand surface wear, also lateral strain, with the minimum amount of stretch. The largest proportion of the production is used for making corsets. It is also utilized in other ways, such as bands for children's garments which may be subjected to a good deal of wear and tear. In tropical countries various grades of coutil are used for suiting where unusual wearing qualities are desired. The weave may be

plain crowded, but is generally a five-harness sateen. The sateen weave allows the cloth to be much closer woven, giving more body without the stiffness which results from crowding the threads. Fancy coutils may be a combination of the plain and sateen weave in stripes, but the usual fancy coutil is a variation of the sateen weave, forming stripes or herringbone patterns, or with dobby and Jacquard figures on a sateen base. In the latter case, the change in appearance of the surface weave is sufficient to bring out the design in the bleached or piece-dyed fabric, though many high grade coutils are woven of bleached and dyed yarns.

Domestic manufacturers of ready-made corsets have for a number of years been satisfied with domestic coutil, and the use of imported coutil is confined almost exclusively to the corsetiers who make only high-priced custom-made corsets. The coutils imported for their use are almost entirely of the best quality fancy types. These are high-count fabrics of two-ply yarns, yarn dyed, or yarn bleached. Designs range from the plain sateen or herringbone to the most elaborate Jacquard brocade in two or more colors. France is the largest producer, especially of the latter. Corsetiers claim that the imported coutil is more carefully woven and has better wearing qualities because of the more general use of two-ply yarn, and it has a better appearance because of the use of yarn-bleached or yarn-dyed material. In addition, they can obtain more elaborate designs and in small quantities of a pattern and color. This feature adds to the exclusive nature of the im-

ported cloth and explains the real secret of its use by corsetiers.

Crêpe. A fine, thin fabric of open texture made of cotton, with a crinkled appearance, used for underwear, children's dresses, rompers, women's dresses, kimonos, etc. The crinkled appearance may be formed in one of many ways:

Methods of Producing Crêpe. The method that is probably most largely used in producing crêpe is the employment of hard-twisted filling yarns which are all regular or right-hand twist. The cloth is woven in rather open weave, and then shrunk to the desired width; in contracting, the hard-twisted filling yarns curl up and give the crêpe effect. Such crêpes can be distinguished by the fact that the fabric shrinks mainly in the width and has a wavy appearance. This method is not suitable for producing crêpe of fine single yarns, as there is a limit to which yarn may be twisted without losing its elasticity, and the finer the yarn the lower the limit.

The usual method of producing fine crêpe is by the use of both regular and reverse (right-hand and left-hand) hard-twisted filling. This method requires a box loom carrying two shuttles. In some cases one pick of regular twist is alternated with one pick of reverse twist; in other cases two picks of each alternate. The latter method gives a slightly coarse crêpe, and in either case the two twists act against each other in the shrinking process so that there is a decided crinkle given to the cloth, but with little of the wavy effect seen in crêpes made of filling twisted only one way. Crêpes requiring yarn too fine to stand the necessary twist in singles are often made of two-ply yarns.

Another effect is produced by mercerization. Cloths are ordinarily mercerized to obtain a lustrous finish; this finish is due to the cloth being kept under tension when subjected to the action of the caustic soda or other mercerizing solution. The caustic soda may be applied so as to crinkle the whole surface or only a portion, in the latter case producing crinkled stripes.

Other crêpe effects may be produced by the use of a special weave, such as a granite derivative of the satin; this is often used in shirting material and gives a rough, uneven effect, similar to crêpe when woven with or without hard-twisted yarns.

The same effect is produced in weaving by having certain parts of the warp threads under different tension. When the fabric is woven in this condition, it causes the cloth to have a crinkled or crêpe effect. The weave is plain, and the yarn is composed of low counts. The plain weave is used because this weave gives the greatest amount of firmness for the least number of threads. Ordinary cotton crêpes are produced in large quantities by American mills. Even though crêpe is largely a style fabric, it is nearly always in vogue for one purpose or another.

Novelty effects may be the result of color or weave combination or the use of artificial silk. Foreign crêpes imported are mainly plain-woven, bleached, piece-dyed, or woven in colors. French manufacturers use crêpe as the base for many figured swivel goods, and when these are in style quantities of plain crêpes, bleached and piece-dyed, are shipped here. These French crêpes are as a rule of a rather flimsy and open-woven construction, though some are heavy shirting crêpes with much the same appearance as ratine. The French crêpes are entirely different from the Japanese crêpes.

Japanese Cotton Crêpe. This crêpe is a plain woven fabric of fairly coarse yarns. It has a rather harsh feel and a decided, though often irregular, crêpe surface. It is imported either bleached, piece-dyed, or color-woven in warp stripes, or with solid color warp and white filling. Its main use is for making ladies' house dresses and children's rompers and dresses. It is particularly well adapted to rompers because of its unusual wearing qualities. This crêpe is made chiefly in the Ashikaga-Sano district of Japan, 80 per cent of the production being from hand looms.

Crash. A fabric made of cotton or linen, from coarse yarns, in a plain, loose weave. It is used for outing suits, towels, skirts, etc. The crashes used for suitings and skirts have a better finish than those used for towels.

Cretonne. A printed cotton fabric used for dresses and decorative purposes.

Crinoline. Crinoline is a fabric composed of cotton warp, horsehair filling, or all cotton yarns. It is sold in varying widths, and is used by tailors and dressmakers in stiffening clothing. It is a cheap cloth of low texture and simple construction, the distinguishing feature being the stiff finish with either a dull or highly glazed face on the cloth. If the fabric is made of horsehair, it is woven on a special loom. The hair is of uniform length and color, and a strand of it is drawn through the opening in the warp. Most crinoline fabrics are made of cotton yarns highly sized. The warp is sized 10% and the cloth 15 to 20%. The warp and filling yarn is 1/20's to 1/26's. The construction runs from 20 to 40 ends and picks to the inch. The cloth is pressed by rollers to give it a " glaze. "

Damask. Generally a cloth of silk and cotton, silk and linen, silk and wool, or all linen in flowered or geometrical designs of large and elaborate character, for drapery or table covering. The weaves used are mostly twills and sateens. It takes its name from Damascus, where it was first made. The materials employed vary according to the purpose to which the fabrics are to be applied.

Denim. This is a strong, heavy, washable fabric, weighing from $4\frac{1}{2}$ to 5 ounces per yard, used for overalls, furniture covering, etc. It is made from single cotton yarn, 9's warp and 16's fillings. The staple is usually low grade fiber, from $\frac{7}{8}$ to $1\frac{1}{16}$". The construction is

usually about 60x40. The weave is two up and one down twill. It may be yarn- or piece-dyed in blue or brown. If it is dyed indigo, a very fast color, it commands a higher price. The finish of the fabric is a rather heavy sizing, after which the goods are dried and pressed.

Diaper Cloth. A figured fabric which gets its name from the Greek *diapron*. It is soft, light, and absorbent, and is made of cotton and linen. It is usually composed of a good grade of cotton, 30's warp and 14's filling. It is woven with a plain or twill weave construction, 62x46, and bleached. Since the fabric is used principally for children's towels it must be free from foreign matter and able to absorb moisture and withstand excessive washings.

Dimity. A light-weight cotton fabric, the distinguishing feature of which is cords or ribs running warpwise through the cloth, and produced by doubling the warp threads in either heddle or reed in sufficient quantity to form the rib desired. The name is from the Greek word meaning two threaded. Dimity is a ladies' summer dress fabric, and is also used for aprons, waists, children's dresses, and sometimes underwear. It is made of regular cotton yarn, from $\frac{1}{60}$'s to the finest counts in both warp and filling. It is made in both white and colors, solid white being used in the most expensive grades. Colors are often printed upon the face of the fabric after it has been woven in the white. The usual construction runs from 56x52 to 120x120. It is finished with a light starching and pressing. Jacquard

designs are not woven in it, because a loose warp thread would be formed, taking away from the evenness and composition of the fabric.

Domet or **Outing Cloth.** This cloth is napped similar to a cotton flannel. It is used for shirts, pajamas, etc., and made with bright-colored stripes and check patterns. The name is from domestic, home made. The construction runs about 36 picks and ends. The yarn runs from 20's to 26's warp and from 14's to 16's filling. The filling yarn has a light twist to permit napping.

Dotted Swiss. A light, soft muslin, decorated with a dotted pattern in heavy yarn. This cloth represents a class of fabrics sold in large volume. They are used for many purposes, such as waists, dresses, curtains, etc. The designs are usually in the shape of small polka dots properly spaced.

Drill. A cotton fabric of medium weight, generally made with the two up and one down twill. It is extensively used for shoe linings and trousers. The construction is usually 66x48, and it is made of coarse yarns, such as 10's to 20's. It may be dyed in the yarn or piece and is finished by sizing and pressing.

Duck. Duck is a heavy, single-cloth fabric made of coarse two-ply yarn, about 10's, lightly twisted and of a plain weave. It derives its name from its resemblance to a duck's skin. It is of lighter weight than canvas. In finishing, duck is taken from the loom and washed and sized, then dried and pressed. If a fancy solid color is desired, the goods are dyed in the piece after the first washing. Duck is used in the manufacture of

sails, tents, car curtains, and for any purpose requiring a good watertight fabric which will withstand rough usage. It has a stiff, hard feel, and excellent wearing qualities. The lighter weights are used for ladies' shirtwaist suits, men's white trousers, etc. Duck is usually sold in grades by numbers.

Eolienne is the name applied to a fine dress fabric characterized by having the filling of a much coarser count than the warp, thus producing a corded effect across the breadth of the goods. This class of goods is made with a warp of raw silk and either cotton or worsted filling, with the warp ends per inch greatly in excess of picks per inch. This silk gives a high luster. The goods are made up in grey, then dyed in the piece in any color the trade desires. The darker shades find most favor for fall and winter use, while the lighter shades are preferred for summer wear. The width is from 27 to 50 inches. The construction usually runs 124x56, and the filling is two-ply 40's or 60's. Since the silk is finer than cotton, the warp has more ends than filling picks. It receives no finish but pressing.

Eponge. This fabric represents a group of soft, spongy cloths made of novelty yarns of very coarse sizes. The construction is low, 16x17. It may be made with a plain warp and novelty yarn filling or plain filling and novelty yarn warp. It is finished by bleaching and dyeing. No other finishing operation is performed.

Etamine. A cloth made of good cotton, 1 1/16 staple, and 10's yarn. The construction runs about

26x28. It is plain woven, bleached, dyed, fairly heavily sized, and pressed. It is sometimes used for draperies.

Farmer's Satin. A lustrous fabric used for linings, made of cotton warp and cotton or worsted filling. It is noted for its durability.

Flannel. There are many fabrics on the market in imitation of the original wool flannel fabric. The principal ones are canton flannel, cotton flannel, and flannelette.

Canton flannel is a medium or heavy weight, soft cotton fabric, with a twill effect on one side and a long nap on the other. It is made of low count yarn, 10's to 20's in the warp and 6's to 14's in the filling. The filling yarn is given a soft twist so that it can be easily napped. The average construction is about 60x44. It is piece dyed in solid (one) colors. This fabric is used in place of wool for underwear, overcoat pockets, etc. The napped surface gives a sensation of warmth.

Napped Cotton Flannel. Made first for trade in Canton, China. The ground cloth has a construction of 80x64 and is made of fine combed yarn, usually 90's. It is bleached in the piece; sometimes printed or dyed. The design is made by a topped or a swivel weave.

Flannelette is a narrow, light-weight fabric composed of all cotton yarn, the filling being soft spun to permit the raising of a slight nap on the back of the goods. The cloth is woven with bleached yarn (warp and filling), the color effects being afterwards printed upon

the face of the goods by the printing machine. Flannelette is made with simple one or two colored stripe patterns, either black and white or indigo blue and white, and in imitation of a Jacquard pattern. It is 27 inches wide, and is used very extensively in the manufacture of ladies' wrappers, kimonos, etc., for house wear. It is composed of single yarns, running from 14's to 30's for both warp and filling. It is woven as plain weave and construction 88x64.

Fustian. A corded fabric made on the order of corduroy and used in England for trouserings, etc. First made at Fustat, a town on the Nile, near Cairo. Velveteen and cordings in the lower, coarser grades were sometimes called Fustian.

Gaberdine. The true gaberdine, which in the past was the largest and most persistent twill import, was piece-dyed and often waterproofed for use as raincoats, but the light weight rubberized fabrics of the domestic industry have now largely supplanted it, except in the case of wool gaberdine, and imports have decreased to small proportions. Such gaberdines as are now brought in are usually waterproofed after importation in order to save the additional duty which must be paid on waterproof cloth.

Galatea Cloth. A printed cotton sateen fabric. Galatea cloth has been somewhat in demand in recent years by women requiring serviceable and neat-appearing cotton fabrics at a medium price. It is used for children's dresses, rompers, outing suits, shirtwaists, etc. It is usually finished 27 inches wide. It is shown in

plain colors as well as in figures, and in dotted and striped designs on white and colored grounds. The patterns are obtained by printing. Some manufacturers have found that they can take a standard type of fabric and extend its use by varying the process of finishing. The base of the cloth — that is, the fabric previous to dyeing or printing or bleaching — is nothing more than an ordinary 5-end warp sateen of fair quality. The cloth is made of yarns usually about 25's warp and filling. The construction runs about 124x56 or 72x120. It is woven in the grey, printed, and given a light starch finish.

Gauze. Originally a veiling net, made in Gaza in Palestine. To-day the name is applied to a variety of fabrics made of a gauze or leno weave, used for lace cloths, dresses, curtains, screens, hammocks, etc. The gauze weave is an imitation or mock leno weave and is produced by interlacing three or more warp threads and sets of three or more filling threads, with open spaces between each set. Sometimes the gauze weave may be made in combination with plain weave.

Gingham. Gingham is a single cloth composed entirely of cotton, and always woven with a plain weave. It is yarn dyed in stripes or checks and was originally of Indian make. It is the most widely known fabric on the market and is made in various grades, having from 50 to 76 ends per inch in the reed, and of $\frac{1}{26}$'s to $\frac{1}{40}$'s cotton yarns in both warp and filling. It is a wash fabric, made in both check and plaid

patterns into which an almost unlimited variety of color combinations are introduced. Ginghams are made with from two colors, warp and filling, to eight colors in warp and six in filling. They are used most commonly in the manufacture of ladies' and children's summer dresses and aprons. Ginghams are finished by sizing, dyeing, stretching, and pressing. There are many types: Anderson, apron checks, zephyr, and Madras. The Anderson gingham is an imported fabric of very fine quality. Apron check is a term applied to the common white and colored check fabrics. Zephyr is a fine dress gingham made of combed yarns counting 40's to 60's warp and filling. Madras is a fine shirting gingham with yarns counting from 50's to 60's warp and filling. It is either a plain weave or in fancy effects obtained by combining a plain weave with a Jacquard or leno weave. Ginghams made of finer yarns, usually in finer constructions, are known as "fine ginghams." Fancy ginghams are ornamented in some manner, either by the use of silk, or by the use of cotton yarns of a different count from the ground warp and filling, in cords or raised stripes or checks; many shirting ginghams are of this type. Whole ginghams are always yarn-dyed fabrics, but there are many imitation ginghams made by printing gingham designs on print cloth. Many of the staple dress ginghams are suitable for shirting, and may be known by either designation according to intended use, the identical fabric and pattern often appearing on both the dress and the shirting-goods counters of a retail store. In such

cases the shirting is usually book-folded and the gingham long-folded.[1]

The cutting-up trade, however, will not use the book-folded shirting, as the crease interferes with the cloth lying smooth under the cutting knives.

Staple ginghams, especially the coarse apron ginghams, are little affected by style variations, and the demand is fairly constant. This is not the case with the plaid and novelty-pattern dress ginghams. These are purely style fabrics brought out to keep the public interested in ginghams. When these new patterns cease to hold the attention of the buying public and ginghams go out of style, the consumption of even the staples decreases and mills are often forced to put their looms on other types of cloth. The vogue for ginghams is claimed to work in cycles, reaching the peak of demand about every seven years. Some gingham dealers state that the beginning of a cycle of demand starts with small check designs, and that the peak year is indicated by the appearance on the market of designs of unusual pattern and varied novelty.

Hickory Stripes. A fabric resembling ordinary ticking, but of a lower texture and softer feel, due to the process of finishing. This fabric is tough and pliable, with good wearing qualities, and is used for " pants " and shirts by very poor people in the South. It is

[1] Long-folded means that a cloth is folded lengthwise along the middle before being folded or rolled on a board into a bolt for sale. Book-folded cloth is placed in packages in lengths that are half that of the cloth as woven.

woven with a $\frac{2}{1}$ forty-five degree twill warp effect in two colors — white filling and colored warp. It is made of 1/14's warp and 1/16's filling and a construction of 66 x 56.

Honeycomb. A twill weave having a fancied resemblance to the honeycomb but consisting really of small diamond patterns, the face and the back of the cloth being reversible. The fabric is executed mostly in cotton, the warp being, as a rule, much finer than the slack twist filling; quilts, bath towels, and bath robes are made of honeycomb cloth.

Huckaback or **Huck.** This is a soft absorbent cotton fabric, in imitation of linen toweling. It is made of soft twisted yarns, 14's warp and 10's filling, and a construction of 50x44. The fabric is sometimes made in white and colored borders with colored stripes.

Italian Cloth is a light, glossy sateen fabric made from cotton and worsted, cotton and wool, cotton and mohair, and all cotton. It is used for linings for the heavier styles of ladies' dresses, also for underskirts, fancy pillow backs, etc. The cloth is woven in grey, undyed yarns. In the finer grades the warp is sized so as to facilitate the weaving process. It is made of good yarn, 40's in the warp and 45's in the filling, and a close construction — as high as 130 picks to the inch. The fabric is bleached, dyed, given a light sizing, and pressed with hot rollers.

Jaconet. A thin cotton fabric, heavier than cambric. If properly made one side is glazed. Derived from the French word *jaconas.*

Jean. A narrow, hard-faced twill fabric made of cotton warp and low-grade wool or shoddy filling. It is woven with hard-twisted 20's cotton yarn. The cloth is given what is known as dry finish — brushed, sheared, and pressed without any washing or sizing. It is used for working trousers, and is dyed a slate black color so as not to show the dirt.

Khaki. A twilled cotton cloth of a brown dust color, first used for men's clothing in India. The word *khaki* is Indian for earth, or dust-colored. On account of its durability and fast dye it is desirable for clothing for people employed in rough work.

Lawn. A light-weight single-cloth wash fabric, weighing from one and one-fourth to two and one-fourth ounces per yard, and in widths from 36 to 40 inches finished. It is composed of all cotton yarns (bleached) from $\frac{1}{40}$'s to $\frac{1}{100}$'s, and is always woven with a plain weave, one up, one down. The name is from Laon, a town near Rheims, France, where lawn was extensively made. Plain lawn is made of solid white or bleached yarn in both warp and filling. The fancier grades, or those having color effects, are produced by printing vines, floral stripes, small flowers, etc., in bright colors in scattered effects on the face of the goods. The patterns are always printed, never woven. Lawn, when finished, should have a soft, smooth feel. Therefore the finishing process includes brushing, very light starching or sizing, then calendering or pressing. Lawns have to be handled carefully in the bleaching process, starched with an ordinary starch mangle (the sizing containing a

little blueing), finished on the stretching machine, and dried with hot air. Lawns are often tinted light shades of blue, pink, cream, pearl, green, and other light tints, with the direct colors added to the starch. They are used principally in the manufacture of ladies' and children's summer dresses, sash curtains, etc. The construction varies from 56x52 to as high as 120x120. There are various types of lawns — Bishop's, Victoria, etc. They are made from high-grade yarns, 80's in the warp and 120's filling, and a construction of 120x120.

Linen Suiting (Imitation). A heavy weight, fairly close but plain woven cotton cloth that is sometimes invoiced as "butcher's cotton," because occasionally used in place of linen for butcher's aprons. Its main use is as a substitute for linen in ladies' and children's wash suits, although it is only recently that any claim has been made for the permanence of the "linen" finish. The linen-like effect is accentuated by the use of coarse and uneven yarns. This cloth was formerly imported in fair quantities because the British finish was considered better than any domestic imitation. Within the last few years, however, American finishers have made great progress, and at least one now produces a finish that is not only more like linen, but has greater permanence than that of the imported cloth.

Lingerie. This term includes all sorts of ladies' and children's undergarments, such as skirts, underskirts, infants' short dresses, chemises, night robes, drawers, corset covers, etc.

Linon. A fine, closely woven plain fabric, well known for its excellent wearing and washing qualities. It is made from combed cotton yarns of long stapled stock to resemble as closely as possible fine linen fabrics. The cloth structure is firmly made in the loom. It is woven of 90's warp and 110's filling and a construction 108 x 110. It is sheared, bleached, lightly starched, and well pressed.

Long Cloth is fine cotton fabric of superior quality, made with a fine grade of cotton yarn of medium twist. Originally the fabric was manufactured in England, and subsequently imitated in the United States. The fabric is used for infants' long dresses, from which it derives its name, and for lingerie. Long cloth to some extent resembles batiste, fine muslins, India linen, and cambric. It is distinguished from these fabrics by the closeness of its weave, and when finished the fabric possesses a whiter appearance, due to the closeness of the weave and the soft twist of the yarn. It is not used as a dress fabric, chiefly because of its soft finished appearance, which is similar in all respects to fabrics which we have been accustomed to see used solely for lingerie, nightgowns, etc. It is made of soft twisted yarns, about 50's warp and 60's filling. It has about the same construction as a lawn. It is finished by bleaching, light sizing, and pressing with slightly heated rollers.

Madras. A light-weight, single-cloth fabric, composed of all cotton or cotton and silk; has excellent wearing qualities. It was at first a light-colored checked

or striped plain-faced cotton-silk fabric, made in Madras, India, for sailors' head-dresses. It is 27 inches wide, and is made of varying grades, weighing from two to three ounces per yard. It is used by ladies for summer skirts, shirtwaists, suits, etc., and by men for shirts. It is known by the white or colored narrow-stripe warp effects, and is made of cotton yarns ranging from $\frac{1}{26}$'s to $\frac{1}{80}$'s warp and filling, and from 50 to 100 or more ends per inch. The utility of Madras for nearly all classes of people permits the greatest scope in creating both harmonious and contrasting color and weave combinations.

The colors most in demand in this fabric are rich and delicate shades of blue, rose, green, linen, tan, lavender, and bright red; for prominent hair-line effects black, navy blue, dark green, royal blue, and cherry or red. In dyeing the yarn, good fast color is necessary, as Madras is a wash fabric. If inferior colors are used, they will surely spread during the finishing processes, and will cause a clouded stripe where a distinct one was intended.

At present most Madras fabrics show very narrow woven, colored-warped stripes on a white background. They are usually woven as a plain weave, although sometimes as a twill weave.

Marquisette. This cloth represents a type of lightweight fabric of very open texture, made of silk, silk and cotton, or all cotton. It may be used for curtains and for overdresses, etc. It is made of high-grade two-ply yarns from 60's to 100's. It is woven with a gauze

or leno weave, bleached, and dyed, with practically no other finish.

Moreen. A heavy mohair, cotton, or silk and cotton cloth, with worsted or moiré face. The making of moreen is interesting. The undyed cloth is placed in a trough in as many layers as will take the finish. This finish is imparted to the cloth by placing between the layers sheets of manila paper; the contents of the trough are then saturated with water; a heavy weighted roller is then passed over the wet paper and cloth, the movement of the roller giving the cloth a watered face. It is then dyed and refinished. The design or marking of moreen is different on every piece. Moreen was at first made for upholstery and drapery use. It was found to give a rustling sound similar to silk, so was taken up for underskirts. The name is from the French *moiré,* meaning watered.

Mull. A soft cotton muslin of fine quality, made first in India, later in Switzerland. The name in Hindoo is *mal,* meaning soft, pliable. In construction and size of yarn this fabric is the same as lawn. It is finished differently by adding an oily sizing solution, which gives a soft finish. It is used principally for dresses, although there is a starched mull used for millinery purposes. This starched mull is given a stiff sizing finish.

Mummy. A plain weave, originally of flax or linen yarn. Originally the winding cloth of the Egyptian mummified dead.

Muslin. A fine cotton cloth of plain weave originally made in Mosul, a city on the banks of the Tigris, in

Asia. There are many varieties of muslin sold under other names, such as batiste, lawn, linen, mull, nainsook, etc., due to difference in construction, quality of yarn, and kind of finish. It is used for many purposes, such as dresses, aprons, shirts, sheetings, pillow cases, etc. Muslin may be made from all varieties of raw cotton, from low grade upland to sea island, from yarns counting from 12's to 100's or higher. The construction usually runs from 44x48 to 100x120. The grey has no finish, while the bleached is finished with light sizing and calendering.

Nankin. Nankin or *inlet* is a fabric in general use by the people of northern and central Europe for ticking and bed clothing, and imports are solely for the use of natives who have emigrated to the United States. These fabrics are plain woven, with a white warp and yarn-dyed filling, differing widely from the standard twill ticking of the American industry. The weave of the imported fabric is crowded and produces a cloth with a hard, smooth surface similar to that of a light-weight canvas. The filling is usually dyed in bright shades of red, but sometimes in blue. Ticking from England is of the same close weave, but is usually in blue with white warp stripes, and is used for pillow ticking where a lighter and smoother material than the domestic ticking is desired.

Nainsook. A light cotton fabric utilized for various purposes, such as infants' clothes, women's dress goods, lingerie, half curtains, etc. The striped and plaid nainsooks are used for the same purposes. When the

fabric is required for lingerie and infants' clothes, the English fabric is selected because of its softness. When intended for dress or curtain fabric, the French-finished fabric is chosen. The latter finish consists of slightly stiffening and calendering the cloth. The fabric may be distinguished from fine lawn, fine batiste, and fine cambric by the fact that it has not as firm construction or as much body, and the finish is not as smooth or as stiff, but inclines to softness, as the fabric has not the body to retain the finishing material. The count of yarn and construction are very similar to lawn, the difference being in finishing.

Novelty-Yarn Goods. Novelty-yarn goods may be divided into two general classes: (1) ratines or sponge cloths, which present a surface entirely of novelty yarn, and (2) slub or novelty-yarn specialties, in which the special yarns appear only in stripes or checks on a basic cloth woven of plain yarn. This basic cloth may be any open-woven dress material such as voile.

Novelty-yarn goods are fabrics woven entirely or in part of novelty or fancy yarn. When the novelty effect covers the entire surface they are called " ratine " or " sponge cloth," the latter being taken from the name *epongé*, given to them by the French. They find their greatest use as ladies' dress and skirt material, but are also often used for bathrobes. Novelty-yarn goods are primarily a style fabric, and to be a success the outstanding effect must be constantly changed. The general surface effect in these cloths is primarily from novelty yarn, the " novelty " being expressed in the

combination of ply, twist, and color of the different ends. For this reason the French call them " effect " yarns. The combination of different types of yarn in varying colors, sometimes with clipped threads, while the secondary factor in the surface appearance is probably the determining factor in the success of these fabrics.

Ratine. This material is usually of low construction and coarse yarn. Ratines have been made from almost every type and combination of novelty yarn. The simplest popular cotton ratines are woven of plain yarn filling and novelty-yarn warp of the spot or loop variety. The loop yarn gives much the same effect as an irregular terry cloth, and the spot yarn presents a surface of nubs or knots of yarn scattered irregularly over the surface. Every season of popularity has brought new types. In fact, new types are continually being brought out in an attempt to popularize these cloths. Some of the most recent types of plain ratine are woven of chain or loop yarn (a continuous series of small or half loops) in both warp and filling. These may be piece-dyed or woven in colors to form a plaid design and in some instances are napped on one side and called " velvet ratine."

Novelty-Yarn Specialties. These often have a much lighter material in the basic cloth, the novelty yarn being used to give a decided contrast in stripes and checks. This is a common way of decorating fancy crêpes and voiles. The novelty yarn is more often of the slub variety, but all types are used singly or in combination.

Few domestic manufacturers had attempted the production of novelty-yarn goods previous to 1912, feeling that they could not produce them profitably. But at this time the demand was very strong, and domestic manufacturers found that the margin of profit was so wide that they could be profitably produced in spite of the fact that most of them must be in comparatively small amounts of any one color.

Organdie. An organdie may be defined as a fine, translucent muslin used for dress goods, hats, sashes, neckwear, etc. The fabric is made in a variety of qualities as regards the counts of yarn used, from 80's to 120's, and in a variety of widths ranging from 18 to 60 inches. The plain organdie is popular in pure white, although considerable quantities are dyed in solid colors, pale blue, pink, etc., while figured organdies are usually bleached pure white, then printed with small floral designs. The printed design is in from two to four colors, and in delicate shades in conformity with the material. Organdie considered in relation to cost as wearing material is rather expensive. The reason for this is that it has a finish peculiar to itself, so that when washed it does not have the same appearance as before, but loses its crisp feeling altogether. At present there are imported organdies that are "washable," that is, will retain a finish after they are washed and ironed. The finish is due to a mixture of albumen and casein, added to the fabric before calendering vigorously.

Osnaburg. A coarse cloth of flax and tow, made in America of cotton, in checks or plaids, and used for

furniture covering and mattress making. The town of Osnaburg, in Germany, made the fabric first. It is made of low-grade cotton, single-ply yarn, 14's to 20's, and a construction of 52x46. It is sold in solid colors, checks, or white warp stripes. It receives no finish.

Penelope Canvas. This rather odd type of specially woven cloth (usually a mock-leno weave) is a negligible import because of small demand. It is not serviceable except for embroidery or beadwork foundation. It is usually woven of rather coarse two-ply yarn, more often in 23-inch width. The weave is very open, but is given a stiff, starched finish. Importers state that the mesh must be accurate as to size, 1/8, 3/16, 1/4 inch, etc., and that it must be woven of even yarns. In sizing, care must be taken to see that while the fabric has the proper stiffness, individual threads can be easily pulled out.

Percale. A closely woven fabric made with a good quality of cotton yarn. The finer qualities are used for handkerchiefs, aprons, etc., and when used for these purposes are not printed, but bleached after the fabric comes from the loom. Percale is chiefly used for dress fabrics, and when used for this purpose is generally printed on one side with geometrical figures, usually black, although other colors may be seen. The fabric is bleached before it is subjected to the printing operations. It is made of single yarn, about 20's, and a construction on the average of 64x60. It is plain weave and may be sold in the grey or white. It is finished with a light starching and tentering.

Percaline. Percaline is a highly finished and dressed percale. The first process to which the cloth is subjected is bleaching, and then it is dyed. After dyeing it is sized to stiffen it and to increase the gloss on the cloth. After sizing it is ready for the calender. In order to give it the highest gloss the cloth is either doubled lengthwise or the pieces are put together back to back, and as it passes through the rolls it is wet by steam, the rolls being well heated and tightly set together. Percaline is used chiefly for feminine wearing apparel, principally for linings, petticoats, etc. These purposes require that the cloth shall be of solid color, the darker colors being preferred, as blue, green, and black. Sometimes it is seen in lighter shades of brown and tan. The most attention is given to the finishing process. It is made of single yarn, 30's to 40's, and a construction 84x84. It is a plain woven fabric.

Piqué. A heavy cotton material, woven in corded or figured effects. The goods are used for such purposes as ladies' tailor-made suits, vestings, shirt fronts, cravats, bedspreads, and the like. It was originally woven in diamond-shaped designs to imitate quilting. The name is French for quilting. The plainest and most common fabrics of piqué are those in which the pattern consists of straight cords extending across the cloth in the direction of the weft. In the construction of these fabrics, both a face and back warp are required, and the cords are produced by all the back warp threads being raised at intervals of six, eight, or more picks over two or more picks of the face cloth, which has a

tendency to draw down on the surface of the fabric. The goods are woven white, and no colors are ever used. The face warp threads are generally finer than the back warp threads, and are in the proportion of two threads for the face and one thread for the back. On the heavier and better grades of piqué, coarse picks, called wadding, are used to increase the weight and to give more prominence to the cord effect. They are introduced between the face and back cloths. In the lightest and cheapest grades, neither wadding nor back picks are used. In this case the back warp threads float on the back of the fabric except when raised over the face picks to form the cord. In the figured piqué the binding of the back warp threads into the face cloth is not done in straight lines as in plain pique, but the binding points are introduced so as to form figures. The fabric is woven in the white, and the figures are purely the result of binding the face and back cloths together. It is usually made of yarn about 30's.

Plumetis. A sheer cotton or woolen cloth having raised dots or figures in relief on plain ground. The design shows a feathery effect, as in embroidery tambour. The name is derived from *plume*, French for feather.

Poplin. Poplin or *popeline* is a name given to a class of goods distinguished by a rib or cord effect running width way of the piece. It referred originally to a fabric having a silk warp and a figure of wool filling heavier than the warp. At present it refers to a ribbed fabric rather than to one made from any particular combina-

tion of materials. It is used for dresses for women and children. Cotton poplin is usually made with a plain weave, the rep effect being obtained either by using a fine warp as compared with the filling, or a large number of ends as compared with picks per inch on both. Irish poplin is a light-weight variety of poplin, sometimes called single poplin, and is celebrated for its uniformly fine and excellent wearing qualities. It is principally made in Dublin. It is made of good cotton, two ply, from 40's to 60's, and a construction of 104x48. It is woven in the grey with a plain weave, bleached, and sometimes mercerized.

The typical poplin has a large number of warp ends and a relatively small number of picks, the warp being very much finer than the filling. The warp is kept slack in weaving, allowing the filling to be beaten up close. As the heavier filling yarn will not bend around the fine warp, all the contraction of weaving takes place in the warp. The effect is much the same as if stiff wires had been used for filling and were entirely covered by the warp threads. Because of this, poplin lends itself readily to weaving in colored warp stripes. Striped poplin is used for shirtings and suitings. The fabric also lends itself easily to simple Jacquard designs by floating warp threads over a number of picks to produce a design. A soft, lustrous surface is usually desired in poplin, and this is gained by mercerizing. To obtain good results in mercerizing, the yarn must be soft twisted, and to offset the weakening results of the soft twist, a two-ply yarn is used. Ply

yarn may also be used in the filling to give a very even rib.

Prints. This term includes a large number of staple plain woven fabrics that are printed with very simple patterns on a white or colored ground. They are inexpensive and are mostly used in house dresses, aprons, slips, etc. They are made from yarns 28's warp and 36's filling, and a construction running from 44x40 to 80x80; the standard runs about 64x60.

Ratine. This term applies to a novelty effect produced on fabrics by novelty yarns that resemble *epongé*. It is used for dresses, sport skirts and blouses, coats, etc. It is recognized by the tufts on the yarn, which produce a rough surface. It is durable and easily cleaned. (See page 284)

Rep and poplin are names given to similar types of transversely ribbed fabrics. They are produced from cotton in a wide range of weights and constructions, and vary from heavy upholstery cloths to light-weight shirting. Intermediate grades are used for ladies' suitings or skirtings and for various other purposes. Both weaves are similar, — simple derivatives of the plain weave, — and are characterized by a continuous series of plain woven ribs across the width of the cloth.

Rep. In a general sense " rep " is used to describe any transversely ribbed cloth, as distinct from cords, which are of a similar structure but extend lengthwise of the cloth. This is especially true of the coarse grades of poplin. In the true rep, however, a heavy-weight filling thread is alternated with a fine one, producing

first a large or distinct rib and then a small one. Some types of rep are woven with all the filling of the same size, the alternating large and small cord effect being produced by the action of the loom.

The consumption of poplin and rep in the domestic market is small as compared with other types of cotton cloth. Domestic production furnishes the bulk of this consumption and includes poplin and rep for practically all uses, from heavy Jacquard-figured or plain upholstery fabrics to medium-weight shirting. Most of these are bleached or piece dyed, the domestic industry weaving very few of these cloths with dyed yarns. No attempt is made to produce the highest quality or very light-weight poplins, which require the very soft twist two-ply yarn in fine numbers. These yarns are unusually difficult to spin and weave.

Imports of these cloths are mainly from England. Actual quantities are comparatively small and confined almost entirely to the highest grades of poplin. The difficulty attached to producing these cloths does not rest so much in the fineness of the yarn, though some are woven of 100 2 warp, but in the very soft twist, which can only be successfully produced on the mule. English fine-yarn spinners use mule spinning almost exclusively and are accustomed to producing difficult yarns. Though the domestic industry can produce these yarns, there is not sufficient incentive to do so under the present small demand. The type of poplin imported is a very fine high-finish fabric, closely woven in fine-ply yarns. These are termed "silk poplins," though made entirely of cotton, and are designed to take the place of high-grade silk shirting. They are produced in plain bleached or cream white, with or without yarn-dyed warp stripes. Heavier grades of fine quality are also imported for ladies' suitings and skirtings.

Sateens. Sateens are cotton cloths which are constructed in the same manner as silk satins, with the object of producing a smooth and lustrous surface. They are made on plain looms using five or more harnesses. In sateen weaves the face is practically all warp or all filling, depending on whether it is a warp sateen or a filling sateen, and the interlacings of the yarns predominating on the face are scattered so as to prevent any obvious twill. The long floats lying side by side hide the interlacings and reflect the light all in one direction, thus giving the smooth, lustrous effect. This luster is improved by mercerizing, schreinerizing, and other special finishing processes. High-grade sateens for dress goods are occasionally woven of dyed and polished yarns, but most sateens are woven in the grey and afterwards mercerized and bleached, dyed, or printed. Sateens are made in a great variety of weights and qualities and are used for many purposes, including particularly linings, corset covers, and dress goods. The best qualities are filling faced. The cloth is made from good yarns, 40's to 80's, (although some coarse fabrics are made from very low counts 15's), and a construction about 64x112. The fabrics are woven in the grey and finished with either a stiff or soft finish and then calendered. The first finish is due largely to considerable starching, while the second is due to an oily solution in the sizing. For purposes of description, sateens may be divided into four general classes: Venetians (see page 299), sleeve linings, bleached or dyed dress sateens, and grey sateens.

Sateen Sleeve Linings. Sateen sleeve linings are very smooth, highly glazed cloths, with a hard, even face, although not a harsh feel. They are occasionally woven of dyed yarns, but usually piece-dyed in black or soft colors and then printed with bright-colored stripes. Many are marketed in the piece-dyed state, without printing. Aside from occasional use as stiffening in the more expensive grades of ladies' and men's clothing, sateen sleeve linings are seldom used for any purpose other than that implied by their name. The most usual weave is an eight-harness warp sateen. The natural sheen of the sateen weave is enhanced and the surface hardened by a subsequent process before printing. In some cases the cloth when taken from the loom is slightly starched, then calendered several times to set the smooth glaze. Another method is by the use of a glazing machine. This consists of a large copper cylinder, four or five feet in diameter, which is heated to a high degree of intensity by either gas or steam. As the cylinder revolves, the cloth passing over its surface is polished by the action of a series of small rollers running in the opposite direction.

Bleached and Dried Dress Sateens. Dress sateens are usually intended as substitutes for medium- and heavy-weight silk dress goods. They are used for various purposes, such as corset covers, skirts, and dresses. Matched in color with silk, they are often used in such portions of a silk dress as are covered by some more or less transparent overdress material. This type of sateen is usually a five- to eight-harness warp sateen,

mercerized and bleached or piece-dyed in plain colors and schreinerized.

Scrim. An open mesh weave of cotton or linen for curtains and linings. The name is from *scrimp*, referring to economy in weaving. It is made from different grades of two-ply cotton yarn, from 10's to 40's. It is woven with a gauze or leno weave in bright stripes or plaid effects. The only finish is hot pressing.

Seersucker. This fabric is plain woven, light weight, washable, with crinkled warp stripes. It is used for dresses, waists, rompers, petticoats, etc. It is made from good single yarn, about 30's. The crinkled effect is produced by giving slack tension to the warp threads in weaving. The cheaper fabrics are produced by printing with a paste of alkalies, which causes the cloth to shrink in stripes where the paste comes in contact with the fabric.

Shade Cloth. This name is applied to a plain woven white or green cloth with a very smooth, firm, lustrous finish, used for window shades. The construction varies, but is similar to those of print cloths. It is woven in the grey, bleached, dyed, and finished with a mixture of oil and starch, dried, dampened, and calendered.

Sheeting. This term is applied to light-weight, plain woven fabrics used for sheets. It is made from different qualities of yarns, from 18's to 40's, and a construction running from 44x40 to 56x60. It is woven in the grey and is sold bleached or unbleached. It receives no finishing.

Silesia is a light-weight, single-cloth fabric, having a rather high texture, and weighing about three ounces per yard. It is composed of all cotton yarn, and is used principally as a lining for ladies' and men's clothing. Silesia is woven of yarn in the grey state, and is dyed in the piece in such colors as black, dark blue, brown, drab, slate, steel, etc. An important feature is the highly glazed or polished face of the goods, which is due to the action of the heated roller in the calendering machine upon the sizing. It is made of good cotton yarn, 30's to 40's, and is woven with a twill weave with a high construction, 90x72. It is piece dyed in dark colors and is given a schreiner finish.

Souffle. The largest designs of crepon show a raised or puffed appearance. *Souffle* is from the French and means puffed.

Swiss. (Also *swisse* and *Swiss muslin.*) Swiss is a variety of thin, semi-transparent muslin, commonly bleached pure white and finished with considerable dressing. The fabric is sometimes woven plain, but more often it is ornamented with small loom-woven dots or sprigs interspersed over the surface at close and regular intervals. The manufacture of swiss originated in Switzerland, where the industry has been established for a long period. At present, however, the material is produced in all cotton manufacturing countries. The finer qualities of swiss embraced under the head of "white goods" range in width from 24 to 28 inches, and are used for women's summer dresses, aprons, etc. Curtain swiss, used for window draperies,

dresser scarfs, and similar purposes, ranges in width from 27 to 45 inches, and is ornamented with a great variety of patterns, as stripes, sprigs, bowknots, fleurs-de-lis, and fancy openwork effects. The texture of swiss curtain muslin is usually coarser than that employed for dresses and is finished with less stiffening. Swiss mull is a fine, plain-woven variety of swiss, finished with considerable dressing, in width from 28 to 36 inches. Its crisp texture particularly adapts the material for the shirred sleeves and wide skirts of women's summer gowns when these are in fashion.

Tape. A narrow fabric composed either of cotton or linen yarns in warp and filling, and usually made with a point or broken twill weave, the break in the weave occurring in the center of the tape, and the twill lines running in a right- and left-hand direction. It is used as a trimming in the manufacture of clothing, also as a binding in innumerable cases, and is sold by the roll, each roll containing a certain number of yards. It is made of all bleached and of regular yarns about 1/26's to 1/30's and 1/40's cotton.

Tarletan. An open mesh of coarse cotton, used mostly in fruit packing, sometimes for dress and drapery. The name is from *tarlantanna*, Milanese for a coarse weave of linen and wool.

Tartans and Tweeds. The name " Tartan " means " clan," and tartan plaids of distinctive color designs were originally worn by members of the various Scotch clans. The original goods were made of wool, but have been commercialized and varied to a considerable

extent in both wool and cotton. They are known as "tartan" or "Scotch plaids," except in the case of check designs, usually black and white, which are known as "shepherd checks." Tartans are highly colored fabrics, the distinguishing feature being large plaid designs formed by three or more colors in the warp and filling. These colors are usually such prominent ones as red, yellow, blue, orange, green, and purple in primary and secondary grades. Cotton tartans range widely in quality, from grades which compare favorably in appearance with wool to the very poorest loosely woven materials. The weave may occasionally be plain in the lower grades, but is generally a twill; the yarns are mainly between 20's and 30's, single or two ply.

Cotton tweeds, like cotton tartans, are woven in imitation of wool fabrics. The usual weave is a twill, and the fabric is distinguished chiefly by the general mixture of color without marked design, unless it is the occasional use of bright colors in stripes. The prevailing tone is an off shade of brown or greenish brown mixed with a small percentage of white. These low-grade fabrics go mainly to the dry goods trade to be sold where a cheap and rather flashy material is desired. Shepherd checks, in which the range of domestic production is probably wider, may be sold to the cutting-up trade as well as to the counter trade.

Terry Cloth or Turkish Toweling is a cotton pile fabric. It is woven in such a way as to permit the forming of a series of loops on each side of the cloth

in regular order. After leaving the loom, each piece is laid separately in the bleaching kier. Then the goods are dried on a tenter frame, given a light starching to add weight, run through a rubber rolled mangle, and again dried on a tenter frame. This cloth is used in the manufacture of towels, Turkish bathrobes, etc. Turkish toweling is the original terry. The name is from the French *tirer*, to draw or pull. It is made from a good grade of two-ply cotton yarn, from 20's to 30's in the warp, and singles of the same count in the filling. The pile effect is produced by the use of an additional warp, which is slack. In weaving, the filling threads are pushed together, and they draw the slack warp threads into loops. The same effect may be produced by wires. The cloth is woven in the grey, then bleached, dyed, or printed.

Ticking. This fabric is used for mattress and bolster coverings, and is made of a strong, heavy twill fabric. It is composed of single yarns, 14's to 22's, the warp a little coarser than the filling. It is a warp-faced twill, made of yarn-dyed warp stripes and white filling. It is finished by brushing, shearing, sizing, and calendering.

Velveteen. A name applied to a cotton-pile fabric with a short pile, used chiefly for dresses, trimmings, and upholstery. It is composed of single or two-ply yarns, from 30's to 80's warp and filling, and a construction of 50x156 to 76x600. It may be a plain or twill weave, with extra filling which floats on the surface of the cloth. The floats are cut, making the

pile. It may be dyed in the yarn or piece and printed or embossed.

Venetian. This fabric has a cotton sateen weave and a higher luster than sateen. The ordinary venetians are woven of single filling and either single or two-ply warp, and are known as single- or two-ply venetians, respectively. These fabrics are usually made of American cotton. The 230–240 thread cloths, while a distinctive feature of the trade, probably made up only 10 per cent of the total. These are usually of Egyptian cotton warp and American cotton filling. Venetians woven of yarns finer than 39's are of two-ply warp and single filling, usually of all Egyptian cotton. This grade of venetian is usually given the " grand marquis " or more often the " marquise de luxe " finish. Venetians, usually fast black, are mainly used for lining men's coats and overcoats. They are also produced in colors for bathing suits and petticoats, and at times have been adopted by the coat and cloak trade in place of union linings and the more expensive silk. A small amount is bleached for skirting, and some is printed.

The majority of the venetians now produced in the United States are similar in general appearance and construction to the Bradford product, but the domestic industry also produces venetians bleached and colored for bathing suits, petticoats, and skirts. Unlike the imported fabric, the domestic venetian is woven entirely of American cotton, and while most of the yarns used are combed, they are all ring spun. As the American industry is organized for high-speed bulk

production, the domestic venetian, unlike the imported, is confined to a limited number of grades. These are produced under the prevailing American method, the spinning and weaving being done in the same plant which sells the cloth in the grey. The standard domestic venetians are confined largely to the one grade of two-ply and one grade of single. This two-ply is woven of 60's two-ply warp and 30's single filling, and has 376 total single threads (2x156x64) per square inch. The standard single venetian is a cheaper grade, woven entirely of 30's single combed yarn and having a total of 220 threads (156x64) per square inch. The usual finished widths of both these grades are 32 and 36 inches, and there is no production to compete with the 54-inch width of foreign manufacture. The 54-inch width, being the same as that of woolen cloth, is more popular with the garment cutters, as it allows them to cut a number of thicknesses of wool and cotton at the same time.

Voile. Cotton voile is a comparatively new cloth that is now made by American mills in enormous quantities, particularly for use in waists and dresses. It is interesting to note that cotton voile and Georgette silk crêpe, two of the most prominent cloths on the domestic market, are of equally recent origin. Although voile is not a crêpe, and the two fabrics are dissimilar in appearance, both are developments of the same basic idea, that of using hard-twisted yarns in both warp and filling. Cotton voile is a light-weight, plain-woven fabric, having a clear, open ground, and

a crisp, thready feel. The open ground is obtained by the use of fine yarns in medium constructions. Clearness can be obtained only with round yarns, having few or no projecting fibers, and this is much aided by the use of combed yarns, preferably made of smooth, long-staple cotton, and finished by mercerizing and gassing. The hard twisting of the yarns gives a crispness and elasticity that is not lost in the soft finish usually given in conjunction with bleaching, piece dyeing, or printing. In two-ply voiles of good quality this crispness will hold through many launderings.

Fancy voiles are largely made by the use of a plain voile ground, ornamented in a variety of ways. Some are made with printed warps. Various stripe and check effects are obtained by the use of plain, dobby, or Jacquard weaves, or by the introduction of color. Considerable amounts are made with silk or artificial silk stripes. In the all cotton voiles and in fancy cotton voiles ornamented with artificial silk, the colored threads must be yarn dyed, but the mixed goods may be cross dyed.

Development of Cotton Voile. Voile was originally woven of worsted yarns, but this never attained any large distribution. The manufacture of voile from cotton yarns was started about 1908 and came into general consumption about 1912. Since then there has been a great improvement in fabric design, in finish, and in methods of ornamentation, and cotton voile has increased in popularity until in recent years it has become the largest seller in the fancy goods

trade. The continued vogue for this specialty has been due to the fact that it has proved more suitable than almost any other fabric for the making of light-weight garments, and has satisfied the demand for a dress material to replace silk. A large proportion of these goods is required in the printed state, and there is evidence of a decided advance, both in the blending of colors and in the use of artistic designs, over the cotton prints of a few years ago. This improvement is in large measure a reflection of the influence of the silk printers, who took up cotton voile printing during the period of the Great War when there was a slackness in the silk trade, and many of the present voile designs are similar to those used in printing silk dress goods.

Types of Voiles. Plain cotton voiles can be divided into three classes, according to the yarns used. The first include voiles woven entirely of single yarns; the second, voiles woven of single yarn and two-ply filling, or the reverse, known as semivoiles; and third, voiles woven entirely of two-ply yarns. Semivoiles are of minor importance. Single voiles constitute the bulk of the domestic production and export. Two-ply voiles make up the bulk of the imports; domestic production of this type is comparatively small and is confined mainly to voiles woven of imported yarns.

Class 1 — *Single Voiles.* Single voile is woven of hard-spun single yarns. These are usually mercerized but rarely gassed, as it is difficult to gas single yarns without tendering. Single voiles average about nine square yards to the pound, or 1.75 ounces per square yard. Widths range from 23 to 56 inches, but the most typical fabric is the 40-inch, weighing 8.25 linear yards per

pound. Various constructions and yarn counts are used for single voiles, but experience has resulted in a construction of 60 warp ends and 56 picks per inch, with hard-twisted 50's, single yarns, in both warp and filling, becoming the standard for the great bulk of the industry. The object desired in voiles is a crisp openness without looseness, and the use of 50/1 hard-twisted yarns in the 60 by 56 construction seems best suited to the desired result. Hard-twisted yarns much coarser than 50's will give too crisp a cloth unless a more open and unsuitable construction is resorted to. Should the yarn used be much finer than 50's, the desired crispness is lost unless the construction is made too fine to give the desired open effect. There are considerable amounts of single voiles made in inferior constructions, such as 58 by 52. Voiles are made by using fine yarns in print cloth constructions, and at times of strong demand print cloths, such as the 391/2-inch, 56 by 56, 6-yard, or the 39-inch, 56 by 44, 6.60-yard, have been stiffened and sold as cheap voiles. These " mock voiles," as they are sometimes called, although using print cloth yarns in the print cloth constructions, are usually made of somewhat better cotton, and therefore of more even yarns, than the usual run of such print cloths.

Class 2 — *Semivoiles.* Semivoile is woven of single warp yarn and two-ply filling, or the reverse. The typical yarn sizes are 50/1 and 100/2, woven in the same general construction as regular single or ply voiles. Voiles of this class of both domestic and foreign origin have been sold in the American market. The two-ply yarn used in domestic semivoiles is usually imported. At the present time there are few semivoiles on the market, as they cannot be sold in competition with the now highly developed single voile and do not approach the quality of the ply voile.

Class 3 — *Ply Voiles.* Two-ply voiles are woven entirely of two-ply hard-twisted yarns, mercerized, and usually also gassed. Although increasing amounts are woven by domestic mills, using imported yarns, most of the ply voiles used in this country are imported. The imported yarns used in domestic voile weaving are mainly 100/2 and 140/2. Fine ply voile yarn is a high-class specialty that requires great care and skill in both spinning and twisting, and although it can be produced in this country, the

domestic mills, requiring only moderate amounts, find it more advantageous to import than to spin. Domestic manufacturers state that the English are better spinners and the Americans better weavers, and therefore that the best results are obtained by domestic weave mills using imported yarns. The English special finishes are also better and more varied, which accounts for part of the import of ply voiles, but most of these voiles are required in the simple finishes which the United States produces.

Two-ply voiles do not adhere so closely to a standard construction and yarn size as do single voiles, although the use of 100/2 voile yarns in a 62 by 56 construction is perhaps the most common, and there are considerable amounts made with 140/2 voile yarns in a 64 by 64 construction. Some two-ply voiles are woven in constructions as fine as 80 by 84, using voile yarns of 160/2 or finer. Fine two-ply voile yarn is much more even, especially when gassed, than single voile yarn, and it can therefore be more closely woven without losing the desired effect of a cloth with square interstices. Two-ply yarn also has a wider range of possible twist, which can be regulated to give the proper crispness in cloths made of different constructions and yarn sizes.

For some years domestic voile finishing of the most usual kinds has been considered equal to the foreign, and this was true of both bleaching and printing. During the recent increase in the use of voiles, American printers forged ahead of foreign printers. The domestic printing industry has been trained by years of experience to change the styles to meet the varying demands of the domestic consumer. When the new styles of printing and color blending began to find favor with the public, the entire industry changed to the new styles. English printers, being more conservative, continued to hold to their old designs. High-grade English printed voile was no longer acceptable to the trade, in spite of the domestic demand for voiles. It may be noted that the most successful importers of printed voile furnished the designs with which their imports were printed.

Wide Sheeting and Tubing Cloth. Wide sheeting is a plain-woven cotton cloth that is woven wide and given a soft, white finish. Widths vary from 40 to

90 inches, with the 81-inch probably predominating. The cloth is cut into suitable lengths and hemmed for use as bed sheets. Tubing cloth is woven on a loom, but differs from ordinary cloth in that it is woven as two cloths, one above the other, which are joined at the edges so as to form a tube. It is cut into suitable lengths, sewed up at one end, and used as pillow and bolster covers. The widths as woven vary from 18 to 24 inches. The use of tubing cloth is not general, as pillow and bolster slips are easily made from ordinary sheeting.

Zephyr Gingham is the finest grade of gingham made and is a light-weight cotton fabric, composed of 1 40's to 1 60's cotton warp and filling yarns. It is woven with either the plain weave or a small all-over dobby effect. It is made in attractive patterns by using good fast colors in warp and filling, and as a cloth has excellent wearing qualities.

Classification of Cotton Fabrics. Cotton fabrics may be subdivided into three distinct classes according to weight and size of yarn: Coarse, medium, and fine. Coarse fabrics are composed of coarse numbers under 20's; medium from 20's to 40's, and fine from 40's to 250's. It is not difficult to recognize the coarse and medium grade fabrics, but it is rather difficult to distinguish some of the fine fabrics, hence the need of a clear statement of the differences in these.

The plain-woven cotton fabrics composed of yarns between 40's and 250's range from cloths of medium weight to those of the lightest weight. They are woven

of unbleached yarn and finished after weaving. The yarns used are spun from high-grade long-staple cotton, combed in all but the coarser numbers. Practically all of the imported cloths of this class are woven of mule-spun yarn, but in the domestic industry the bulk of the yarn used is spun on the ring, and only the finest cloths contain yarn spun on the mule. The fabrics are commonly termed "fine plain white," this being the usual finish, though many are marketed piece dyed or printed. In recent years increasing quantities have been handled commercially in the grey or unbleached state, especially in the case of imported fabrics.

These fine plain-woven cloths are used mainly in making underclothing, dresses, waists, blouses, women's woven collars and cuffs, veils, and children's clothes. Some are used for household purposes, and special types are used as the basis for machine embroidery and for making typewriter ribbons.

The basic cloths in the order of relative weight per square yard, from medium to fine, are: *Longcloth*, *typewriter cambric*, *nainsook*, *ordinary lawn*, *India lawn*. The name cambric is sometimes applied to longcloth and nainsook when in the grey, and occasionally when bleached and soft finished. India lawn is usually called India linon. These may be separated into two general classes by general characteristics and use. The first class contains longcloth, typewriter cambric, and nainsook; the second, the four general types of lawn. The distinction between the two groups lies in the greater body and closer weave of the longcloth, typewriter

cambric, and nainsook. No distinct line based on weight and construction can be drawn between the two groups, however, as in both particulars the nainsooks and coarser lawns overlap to a large extent. The wide range of combinations in construction and yarn count commonly employed in the weaving of these cloths is largely responsible for this overlapping, though inconsistencies in nomenclature are often a matter of opinion or of finish. For instance, the distinctive soft nainsook finish is often given to an ordinary lawn, which may then be called nainsook; or fine nainsook may be given a distinctive lawn finish and name.

The first class may be termed the undercloths, as the bulk of the longcloths and nainsooks are used for underclothing, although fair quantities are used for machine and hand embroidery and are known as embroidery muslin. The best quality cloth of this class is that specially woven for making typewriter muslin or ribbon. When bleached it is sometimes known as nainsook or cambric. Longcloth, nainsook, and typewriter ribbon are usually given a soft bleached finish. Nainsooks are often piece-dyed in pastel shades. When starched and filled, longcloths are called cambric or cambric muslin.

The second class contains the four general types of lawn which constitute the range of the lighter weight, plain-woven cloths. These are largely used for outerwear purposes. Varying the construction, weight, and finish in these cloths has become such a general practice that even these main types have lost their individuality.

While the name used signifies a distinctive type within certain limits of weight and construction, the limits overlap to a large extent. In a general way, ordinary lawn will contain yarns averaging from 50's to 70's, India lawn from 60's to 100's, Persian lawn from 80's to 150's, and French lawn from 120's up. Special names, often denoting finish alone, are sometimes applied in the place of the usual ones.

Considering the imported cloths, some of the most common names applied to the finished lawns are: *batiste, lyklinen, bishop's lawn, Victoria lawn, pearl* and *pearl luster lawn, opal lawn, mull, India mull, chiffon, organdie, tussorine lawn,* and *tie lawn.* Aside from organdie, few of these names denote any distinctive characteristic as regards construction or finish, being applied according to the whim of the manufacturer to a large part if not the entire range of lawn construction. In general, batiste, lyklinen, and bishop's lawn are usually crisp and linenlike; pearl and pearl luster lawns are usually soft, in the latter case often slightly lustrous; mull, chiffon, and tussorine lawns usually have soft, mercerized, silky finishes; and tie and Victoria tie lawn are usually clear and slightly crisp.

Organdie, the most distinctive of all lawn finishes, has a very crisp and usually rather transparent finish, which is sometimes of a permanent nature. It is the newest of the more popular finishes and has largely superseded, at least in name, all other types of clear and crisp finished lawns. During recent years the mounting popularity of organdie has brought keen competition

and resulted in widespread production, with considerable improvement in this type of finish. Domestic production of organdie and finished lawns has increased rapidly, and while the cloths made are for the most part coarser than those imported, some of the finishes are said to be permanent and in appearance equal to any of the imported organdies, with the exception of those from Switzerland.

A large proportion of imported organdies are from the United Kingdom and a few from France, but the most comprehensive range and those of the finest and most permanent finish are from Switzerland. These are not all woven in Switzerland, considerable quantities being shipped there from England and other countries for finishing. This is due to the development by the Swiss of a superior and more or less secret process which produces a permanent finish of the clearest and most transparent appearance.

Napped Goods. Some of the staple napped goods are: flannelette, domet, cotton duvetyn, molleton, and moleskin.

Flannelette. A light-weight cotton cloth, usually plain woven and napped on both sides. Imported flannelettes are mainly of the finest qualities, in typical shirting designs, for use as men's shirts or ladies' sport waists.

Domet. A name applied to many types of heavy and medium weight napped fabrics. In the domestic trade it is usually a yarn-dyed napped fabric, used for outing clothes and for making shirts and pajamas. The leading import, however, is a plain-woven, bleached,

embossed fabric, which is napped on the portion of the surface left uncalendered by the embossing. This import is used for lining coffins of the cheaper class.

Cotton Duvetyn. A plain-woven fabric of heavy weave, usually piece dyed, and heavily napped on both sides. It is most largely used for millinery and trimming purposes as a substitute for the higher priced wool or union duvetyn.

Molleton. A double-texture cloth, bleached, with a dense nap raised on either side. It is often called "silence cloth" or "table felting," and is used under the linen tablecloth to prevent damage to the finish of the table and to make the tablecloth look whiter. Standard widths are 54 and 64 inches.

Moleskin. A strong, smooth, cotton fabric made with one set of warp and two sets of filling, the face usually being a modified sateen and the back twilled. The cloth is usually piece dyed or bleached and the twilled side given a slight nap. Moleskin is used for riding trousers and other clothing where unusually heavy wear is expected; it is also used for heavy-weight raincoats.

QUESTIONS

1. Distinguish between muslin and sheeting.
2. What are the different kinds of napped cotton fabrics? Describe them.
3. What is the difference between rep and poplin?
4. Distinguish the following from each other: Lawn, batiste, organdie, and nainsook.
5. Distinguish between printed Madras and dyed Madras.

6. What are the characteristics of gingham? chambray? print?

7. How would you distinguish between a coutil, drill, duck, and canvas?

8. How is buckram made? What makes it very hard?

9. Is it possible to tell the difference between a woven dotted Swiss and a printed dotted Swiss? If so, how do you determine which is which?

10. Distinguish between a venetian and a satin (sateen).

11. How would you tell the difference between mercerized sateen and one that has about the same luster but has not been mercerized?

CHAPTER XVI

SILK

Importance of Silk. Silk is the finest, most elastic, and most durable of all textile fibers. The filament of silk is stronger than steel wire of the same diameter. It is especially prized for its brilliant luster, elasticity, and beauty.

Raw Silk. The silk industry comprises four general branches: (1) The production of cocoons; (2) the reeling of the silk from the cocoons into skeins of raw silk; (3) the manufacture of spun silk (or schappe) from waste silk; (4) the manufacture of the raw silk and spun silk into goods.

Although silk is produced by cheap labor, it is the most costly of fibers because of the great amount of time and care involved in raising the worm and obtaining the silk (called reeling) from the cocoon. Silk comes from the cocoons of several species of caterpillars called silkworms. The one that produces the bulk of the world's silk, as well as the best, is the *bombyx mari*, which has been raised indoors for centuries and is called the cultivated silkworm. There are certain silkworms that grow wild and are called *tussak* silkworms. The worms are hatched by subjecting the silkworm eggs, each one almost the size of the head of a pin, to artificial heat.

In Japan about 60 per cent of the crop is usually produced in the spring, about 10 per cent in the summer, and about 30 per cent in the autumn. The worm develops a very strong appetite, which requires a large amount of freshly picked mulberry leaves. It grows so rapidly that in the course of a little more than a month it sheds its skin and acquires a new one.

After reaching full development, the worm climbs and begins to spin its cocoon or silk envelope above its body. In doing so it gives off a jelly-like substance which it twists about its body. As soon as the silk fluid is exposed to the air, it hardens. This jelly-like substance contains a filament of silk with a gum. The worm completes its cocoon in about three days, then changes

MOTH, SILKWORM, AND COCOONS

into a chrysalis, which, if not killed, within a fortnight develop into a moth that breaks its way out of one end of the cocoons. The female moth dies shortly after laying her eggs. The cycle from birth to death, including all transformations, is less than 60 days. As there is a lapse of about 10 months between the laying time and the next hatching, some silk firms have extensive cold storage rooms for keeping the eggs.

Since pierced cocoons from which moths have emerged cannot be reeled, only about two per cent of the chrysalides are allowed to develop into moths and emerge to lay eggs for the next crop; the remainder are killed in the cocoon, usually by stifling in hot, dry air. About 10 per cent of the cocoon crop consists of *doupions*, or double cocoons, where adjacent worms have spun their cocoons side by side and have so interwoven them that the two filaments

must be reeled together. Such silk is so coarse and uneven that it is usually kept for local manufacture, though some is exported for use in making goods of rough appearance. One hundred female moths will produce about one ounce of eggs, numbering 35,000 to 40,000 (each moth laying 300 to 400 eggs), these yielding a similar number of cocoons, which will weigh, undried, about 160 to 190 pounds. The weight of the individual cocoons may vary from 16 to 50 grains each, undried. It takes about 11 pounds of undried cocoons (equal to about 4 pounds of dried cocoons), to produce one pound of raw silk. Cocoons which have been pierced by the escaping moths have only a limited value as a material for making spun silk.

Numbering Raw Silk. Raw silk is measured in numbers called deniers. A denier represents a definite weight, .05 grams. A definite length of silk, 450 meters, is weighed in denier units. The number of units represents the size. To illustrate: if 450 meters of raw silk is weighed and found to weigh .8 grams, then the size is $\frac{.8}{.05} = 16$ deniers. The silk may vary in fineness two deniers hence the size is written 16/18. Size is the weight of 450 meters in deniers.

Reeling Raw Silk. A single strand is too fine to use commercially, so it is necessary to join several to form a suitably strong thread. This is done by reeling. There may be thus joined strands from three cocoons or more, but in this country the size known as 13/15 deniers, generally reeled from six or seven cocoons, is by far the most extensively used. One pound of 13/15 derniers will measure about 181 miles.

Reeling is a simple but tedious process, as it requires the production of from 2500 to 3000 silkworms to produce a pound of raw silk. The reelable silk in a cocoon varies between 300 and 700

yards; only about half, and that the middle length of the silk as spun by the worm, is strong and even enough for reeling. As stated above, in most cases six cocoons are reeled into one to form the raw silk, but the number varies from 3 to 12 or more, according to the quality of silk and the size of thread desired. The cocoons that are to be reeled together are placed in a basin of warm water. After the natural gum with which the fiber is combined

REELING RAW SILK

has softened, and the outer coating of loose and uneven fibers is brushed off, the *reeler* finds the ends of the true or reelable filaments and runs them on the reel together; the filaments stick to each other and form one thread by reason of their softened gum. The silk is cleaned and twisted in reeling, either by bringing the threads back and passing each around itself about 200 times in a seven-inch spiral, or by twisting the threads of two different basins around each other before they are passed on to separate reels.

The best raw silks are produced in steam filatures. The water in the basins is heated by steam and kept at a uniform temperature; the reels are power driven, and care is taken to produce even and reliable sizes.

Many filatures still use hand power; country silks are always reeled in this manner. Silks such as Chinese *tsatlees*, for example, are usually very inferior, as the home reelers employ primitive appliances and, owing to lack of supervision, are careless in their methods. A contributing cause of their irregularity is the haste with which cocoons have to be reeled. The chrysalides in these wild silk cocoons, which constitute the bulk of the Chinese crop, are not stifled, so the silk has to be unwound within two weeks after the cocoons are gathered from the trees, before the moths have time to emerge. For brilliancy, whiteness, and "nerve," however, such silks are unsurpassed. Most of the country silks, as well as some filature silks, must be rereeled before they are acceptable to throwsters abroad. In rereeling, the hanks are sorted for size. Then, after foul threads and bad piecings have been taken out and the threads subjected to a cleaning process, they are run off into the smaller standard skeins.

Japanese raw silk is mainly shipped in bales weighing about 140 pounds gross each, and about 7 bales make up a ton of 40 cubic feet. The steamship companies have the option of charging by weight or measurement, and, as they can make more on the weight, the charge for raw silk is per hundred pounds.

When taffetas are in fashion the 13/15 deniers is the leading raw-silk count imported. In the last two years, however, with the vogue of Georgette crêpe and crêpe de Chine, there have been larger imports of coarser counts, especially the 16/18, 18/20, and 20/22 deniers, the latter predominating. Japanese raw silk is numbered according to the standard denier system, which is now almost universal, the count indicating the weight in 5-centigram deniers of a 450-meter hank.

The fineness of cocoon filaments varies considerably with different silks, during different seasons, and at different portions of each cocoon. In general, Cantons will average under 2 deniers, Chinas (Shanghai) about 2 1/4 deniers, while Japans usually vary between 2 1/4 and 3 deniers. Some Japanese cocoon filaments,

however, are found as fine as 1 3/4 deniers, while some run coarser than 3 1/2 deniers. In all cases the middle portion of the cocoon filament is the thickest and heaviest portion.

History of Silk. Silk was used in the East as a fabric for the nobility. It was first used in China and later in India. It was brought into Europe about the sixth century. Up to that time the Chinese had a monopoly of the industry. By the tenth and eleventh centuries silk fabrics were made in Spain and Italy. At the close of the sixteenth century silk was being produced at Lyons, France. It was afterwards introduced into England, and the English silk for a long time replaced the French in the European market. At the present day Asia and southern Europe supply the world with the raw material, the main silk-producing countries being Japan, China, and Italy, followed by Turkey, Russia, France, Austria, Hungary, Persia, India, Greece, Spain, Indo-China, and the Balkan States. The demand for raw silk is steadily increasing, and the production has about doubled in the last quarter of a century. In the export of raw silk China maintained its supremacy until within the last decade, when Japan assumed first place. The growth of sericulture in Japan during the last few decades has been phenomenal: caterpillars now spin their cocoons in the homes of over a fourth of the entire farming population, and raw silk is the principal export of the empire.

Thrown Silk. Thrown silk may be defined as yarn made from raw silk, that is, from silk reeled from the cocoon. Raw silk consists of several parallel cocoon

filaments held together only by the natural gum. It cannot be boiled off, dyed, and weighted, and remain in workable condition. Therefore if silk is to be skein dyed it must first be thrown into yarn.

Silk "throwing" (from the Saxon *thrawan* to twist), is the technical term used for the processes involved in making yarn from raw silk. As raw silk is already in the form of a continuous strand, there is no occasion for the preparatory machinery that is needed for all other textiles, where a mass of short, tangled fibers of varied lengths needs to be transformed into a continuous length of roving. In silk throwing the main object is the insertion of twist into the raw silk, with such doubling as may be desired.

Thrown silks are known as *organzine*, *tram*, or *single*, according to the method of manufacture.

Organzine. Organzine, mainly used as warp, is made by doubling two or more threads which have first been well twisted in the single, and then giving them a firm twisting in the opposite direction eight or ten turns to the inch. Crêpe yarn is organzine with 40 to 80 turns to the inch.

Tram. Tram, mainly used as filling, is made by combining two or more raw silk threads, and then twisting them together with a slack twist in two to four turns to the inch. Strength is not essential in the filling as it is in the warp, and the slack-twisted filling permits a more brilliant finish.

Singles. Singles are single raw silk threads, twisted or not. Such yarns, when very hard twisted, are used

for the warp and filling of chiffon and kindred fabrics. Some singles are woven in the gum, without twist, and produce cloths which, after being boiled out and bleached, have a softness and brilliancy unattainable in cloths made of twisted yarns. The famous *habutae* of Japan is a striking illustration of such work. At least a fourth of American raw silk imports, however, is woven in the grey, without any throwing.

Manufacture of Silk Yarns. More than two thirds of the thrown silk used in the American industry is thrown on contract by commission throwsters, either for weaving mills or for silk merchants. Most of the throwing mills are located in Pennsylvania, gravitating toward the coal mining region, where fuel is cheap and where cheap female labor is available, since the mines employ only males.

The processes in a throwing mill are as follows:

For organzine:	*For tram:*
Soaking	Soaking
Winding	Winding
Spinning first time	Doubling
Doubling	Tram spinning
Spinning second time	Reeling
Reeling	

When the raw silk in skeins is received at the throwing mill, the skeins are first weighed, assorted according to quality, and tagged to indicate the manufacturer for whom the silk is to be thrown, and whether it is for organzine or tram. The skeins are put into light cotton bags and soaked overnight in warm, oily soapsuds (to

soften the natural gum), dried, placed on reel swifts, and wound off on small double-headed bobbins.

Sometimes dirty and irregular silks may require cleaning. In such cases the silk is transferred from one bobbin to another, passing during the transfer

WINDING SILK ON SWIFTS

through a cleaner, which consists of parallel plates set just far enough apart to catch any irregularity in the thread.

Winding. After winding, the tram goes to the doubling frame, but the organzine goes to the first-time spinning frame. The principle of spinning or twisting consists of winding threads on a horizontal bobbin

from a vertical one that revolves at a faster speed. The yarn runs through the eye of a little metal flyer on the top of a vertical bobbin, and the difference in speed between the two bobbins regulates the amount of twist. In other textile industries, "spinning" is a process by which roving is drafted or attenuated and then twisted into yarn. In the manufacture of yarn from raw silk no drafting is possible, and the spinning process is one of twisting only.

Doubling. Doubling is a process by which threads from two or more bobbins are wound together, without twisting, on another bobbin.

Second Time Spinning. In the second-time spinning, the machine is similar to that used for first-time spinning, but, instead of inserting twist into single threads, it twists into one the threads which the doubling machine has brought together. The direction of the twisting machine is opposite to that in the single thread.

Reeled into Skeins. During the spinning process the thread is wound upon bobbins. Before being dyed, the thread must be reeled again into skeins. The skeins are laced by running short strings in and out through each skein, dividing each into four parts, so as to prevent tangling during the dyeing process. These are then made up into compact bundles.

The work of the throwster usually ends with reeling and bundling, and the skeins are then sent to separate establishments, where they are dyed and then sent to the weaving mill.

Tram Spinning. In tram spinning, the original

thread is not twisted, but, after winding, two or more of the raw silk threads are doubled and then twisted together with a slack twist of from two to six turns to the inch. They are then reeled and bundled and sent to the dyehouse, as in the case of organzine.

It is obvious from the above that, since yarn is produced from raw silk with fewer and simpler processes than from any other textile fiber, the better the silk, the less the trouble and expense. In the United States the high average of wages paid makes it essential to get the maximum production from each operation. Manufacturers do not find it economical to employ many grades of silk that are always used in other countries. For this reason, only the better grades are imported.

Numbering Thrown Silk. In the United States, as in England, thrown silk is usually numbered according to the weight in drams of a hank 1000 yards in length. In Continental Europe thrown silk is numbered the same as raw silk, which is usually by the weight in deniers of a hank 450 long. To reduce denier counts to dram counts, divide the deniers by 17.44. Thus, four-thread tram of 16/18 denier size would be $17 \times 4 = 68 \div 17.44 = 3.90$ drams. There are 256 drams to the pound avoirdupois.

Very little thrown silk is imported into this country. The throwing industry in the United States is very highly developed, as manufacturers prefer to buy the special quality of raw silk desired and then have it thrown according to their particular needs.

Making Silk Cloth. Silk cloth is made in practically the same way as other woven fabrics. The thrown silk is wound on bobbins or spools. From these bobbins the organzine is run off into warps, and the tram is wound on a special kind of shuttle bobbins, called quills. The weaves are exactly the same as the weaves in other fabrics — plain, twill, satin, Jacquard, pile, etc. Silk fabric may be made from either raw silk, tram, organzine, or crêpe yarns. Raw silk is made into silk fabrics in China and Japan, and is sold by weight mommies to the yard. There are about 7–1/2 mommies to the ounce. A four-mommie cloth would be about a 1/2 ounce fabric. *Habutae* is made of raw silk.

Silk fabrics in this country are made of organzine in the warp, tram in the filling, or crêpe yarn in either warp or filling.

Iridescent. In silk weaving this is a color effect produced by the use of warps and wefts of different tints and hues. Properly, iridescent effects exhibit alternating or intermingled colors like those of the rainbow, as in mother-of-pearl. In its more general application the term describes any glittering of colors which change according to the light in which they are viewed, without reference to what colors they are, so long as they present a changeable metallic sheen.

Dyeing. After the silk has been thrown, it is usually reeled into skeins, and sent to the dye-house to be colored. The principal operations in the skein dyeing are the boiling-off, weighting, and coloring processes.

As part of the raw silk thread is composed of a soluble gum which detracts from its luster and feeling, it is usually desirable to " boil off," or discharge, this gum in the thrown silk before proceeding with the other processes.

The silk fiber remaining after the boiling-off is then lustrous and brilliant, and of a light creamy white. If it is to be dyed " pure dye," the coloring is next proceeded with, and the weighting added.

Should it be desired to increase the thickness of the silk, a process called " weighting " precedes the coloring. Silk has a great affinity for many substances, such as tannins, sugar, salts of different metals, etc., and when immersed in solutions of such substances will absorb and retain a considerable amount, thus adding to both its bulk and weight. By careful and scientific treatment, not only can the weight lost in the boiling-off be replaced, but a large additional weight can be imparted, particularly in blacks.

The weighting of silk is an expensive and complicated process, but as it makes possible the production of sound, useful, and sightly qualities at much lower prices than otherwise would be possible, its use, within the dictates of prudence and the limitations of good practice, is of economic value to the consumer. Most yarn-dyed goods are weighted to some extent.

Silk occupies in several respects an intermediate position between the animal and vegetable fibers. Like wool, it is a highly nitrogenous body, but contains no sulphur. It readily takes up many of the colors which

can be worked upon vegetable fiber by the aid of the mordants. This is particularly the case with reference to a large number of aniline colors, which require merely to be dissolved and mixed with perfectly clear water in the dye vessel. The great attraction of silk for these colors simplifies silk dyeing exceedingly. The sad colors, on the other hand, and especially black, are in many cases exceedingly complex, the main object of the dyer being not so much to color the silk as to increase its weight.

Dyeing black is unquestionably the most important branch of silk dyeing, and it has probably received more attention than any other branch, in consequence of which it has been brought to a high degree of perfection. Blacks on silks are produced both from natural and artificial coloring matters, the former having, so far, retained their preëminence despite the recent discoveries of chemists. For various reasons coal-tar colors have never proved successful in dyeing black on silk. Since the discovery of America, logwood blacks have formed the staple of the black-silk dyer, who has carried their production to a high degree of excellence. But unfortunately, besides aiming at a high state of perfection in the actual dyeing operation, the black-silk dyer has also aimed at increasing the weight of the dyed silk, so that nowadays it is possible for him to receive ten pounds of raw silk and to send out fifty pounds of black silk, the extra forty pounds being additions made in the process of dyeing.

Logwood black-silk dyeing consists essentially of

alternate dippings in separate baths of the mordant and dyestuffs suitable for producing the required color and weight. The number of dippings and the length of time taken in each operation depend on the intensity of the black wanted and the amount of weighting desired. The chief substances used for weighting are lead salts, catechu, iron, and nut-galls, with soap and oil to soften in some degree the harshness of the fabric which these minerals cause. As the details of the operations are practically the same for all kinds of logwood blacks (raven, jet, crape, dead black, etc.), the method for producing one will suffice for all. The process involves several distinct operations, as follows:

1. *The Boiling-off.* This is the removal of the gum and natural coloring matter in the silk. It is accomplished by boiling the skeins of silk in water and good olive oil soap for about one hour. This dissolves the gum and leaves the fiber clean and glossy.

2. *Mordanting.* This is done in a bath of nitrate of iron, in which the skeins of silk are allowed to remain one hour. The silk gains some in weight in this operation by absorbing a quantity of the iron in the bath. After having been dipped in the first bath three or four times, it is ready for the soap and iron bath, in which it is repeatedly immersed, the operation causing a deposit of iron-soap on the fiber, which adds to its weight but does not lessen its flexibility and softness. Eight dippings in the iron and soap bath increase the weight of the silk about 100 per cent.

3. *Blue Bottoming.* The next operation is to dye

the silk blue, which is done by immersing it in a solution of potash. In this it is worked for half an hour, when it acquires a deep blue color. It is then taken out, and after rinsing is ready for the weighting operations.

4. *Weighting Bath.* A catechu bath is now prepared, in which the silk is entered and worked for an hour, and then allowed to steep over night. The result is that the blue on the silk is decomposed, and the goods by absorbing the tannin in the catechu increase in weight from 35 to 40 per cent. This bath is the most important one in the dyeing of weighted black silks, as the dyer can regulate the strength of the bath by the addition of tin crystals so as to increase the weight of the silk to an astonishing degree. The proportion of tin crystals used is regulated by the number of iron baths that have previously been given the silk; if two baths of iron have been given, 5 per cent of tin crystals is used; if four baths, 10 per cent, and so on. The action of these chemicals is somewhat complex. All that is known is that by reason of some peculiar quality possessed by silk it is enabled to combine with iron and tin, and that exposure to the air after the baths fixes these chemicals permanently upon the fibers, thus increasing their weight to almost any desired extent. Silk, according to its quality and weight, will take up of these substances from 50 to 200 per cent without creating much suspicion. Instances have been known in which silk has been increased nine times its own weight. All the operations thus far have had for

their object the weighting of the silk, although the blueing and the catechu baths have some influence on the finished result. After these come the dyeing operations proper, two in number, mordanting and dyeing.

5. *Mordanting.* A bath of iron liquor heated to 130 degrees F. is provided. The silk is entered, worked well for one hour, then wrung out and hung up to "age" for two hours, after which it is ready for the logwood dye.

6. *Dyeing.* A bath of logwood liquor is prepared, to which is added 10 per cent of fustic, and the solution is brought to a temperature of 150 degrees F. In this the silk is entered and worked for an hour, then taken out and wrung dry. Sometimes the black does not come up full enough, and in such cases the bath is repeated.

7. The final operation has for its object the restoration of the luster and suppleness of the silk, which has to some extent deteriorated from the many operations through which it has passed. The brightening and softening of the fiber are effected by immersing the silk in a bath of olive oil in the form of an emulsion. In this the silk is worked until it is thoroughly impregnated with the oil, when it is taken out and wrung dry, after which it is ready for the loom. Practically the same process is followed in piece dyeing, though only inferior grades of silk are dyed in the web.

Colored Silks. This class of silks is generally purer than black and sad-colored silks. It is not nearly so easy to weight the former as the latter, for the reason

that there are but few substances capable of giving weight which do not interfere with the effect of light-colored dyes. The weighting agents most generally used are sugar, acetate of lead, and tin tetrachloride. The weighting by sugar is done after the silk is dyed. A solution is made of pure lump sugar by placing it in a large copper pan with water and heating until dissolved. In this bath the silk is thoroughly saturated, and then dried and finished; or, the dipping process may be repeated several times if desired. One dipping will weight the silk about 12 per cent, two about 20 per cent, and three about 30 per cent. In a solution of acetate of lead, each dipping will weight the silk about 8 per cent, and may be repeated as often as it is wished. In this case the weighting is generally done on the undyed, boiled-off silk, although it may be done on the dyed silk if the color is such as will stand the acid.

Mixed Silk Fabrics. Until lately silk was invariably dyed in the state of yarn. When the silk was to be woven into mixed fabrics, such as satin, gloria, etc., it was impossible to dye both fibers exactly the same shade. Formerly such fabrics were woven with the cotton and silk yarns dyed separately, care being taken to match them as closely as possible. The weaving of dyed yarns of different fibers is open to the objection that when the fabric comes to be finished there is a wide difference in the color, no matter how closely they may have matched in the beginning.

Piece Dyeing. If the goods are woven with the gum still in the silk, it must be taken out afterward,

and the goods either dyed in the piece or prepared for printing.

Finishing. All silk goods, whether yarn dyed or piece dyed or printed, are given some kind of finish; sometimes it is no more than is necessary to smooth out the wrinkles. There are many finishing processes by which goods may be treated. They are run through gas flames to singe off loose fibers, and over steam cylinders to dry and straighten them, over a great variety of sizing machines to stiffen them with starch, gelatin, or glue. There are calenders or heavy rolls to smooth and iron them, steam presses of great power to press them out, breaking and rubbing machines to soften them, and tentering machines to stretch them to uniform width. There are also moiréeing or watering, embossing, and various other machines for special purposes.

Waterproofing. One of the greatest difficulties with which the manufacturer of piece-dyed and printed silk goods has to contend is the ease with which they become spotted with water, and for a number of years many people have tried to prevent this by various processes. There are no less than two hundred such processes patented. Most of them have not met with much success, as they injure the feel or strength of the goods. The complexity and number of processes for treating silk goods may be realized when we know that a piece-dyed or printed fabric is handled its entire length between fifty and one hundred times or more after it comes from the loom.

Moiré. Moiré is a waved or watered effect produced upon the surface of various kinds of textile fabrics, especially on grosgrain silk and woolen moreen. This watered effect is produced by the use of engraved rollers and high pressure on carded material. The object of developing upon woven textiles the effect known as moiré is the production of a peculiar luster resulting from the divergent reflection of the light rays from the material, a divergence brought about by compressing and flattening the warp and filling threads in places, and so producing a surface the different parts of which reflect the light differently. The moiré effect may be obtained on silk, worsted, or cotton fabrics, though it is impossible to develop it on other than a grained or fine corded weave. The pressure applied to the material being uneven, the grained surface is flattened in the parts desired. In the Middle Ages moiré was held in high esteem and continues to enjoy that distinction. It is used for women's dresses, capes, and for facings, trimmings, etc. Fabrics with well-defined and firm ribs, such as bengalines, etc., respond best to this operation, and a wide variety of effects is obtainable by treating the fabrics in various ways.

The classic way of making true moiré, called *moiré antique* or *moiré anglaise*, is by folding the ribbed material lengthwise, face in, the selvedges covering each other and stitched together at intervals to prevent slipping. The fabric is placed between closely and very evenly woven linen or cotton which is dampened. The whole is calendered several times; sometimes the cloth

is not dampened before calendering. Very light fabrics are dressed on their reverse side with glue, size, etc., and after drying run between heated rollers. The moiré thus produced will have large designs showing a great variety and without repetition, but symmetrical on the sides.

Although cross ribbed materials are usually selected for the moiré process, flat fabrics, like taffeta or satin, are also given similar finish by means of rollers engraved with a moiré design which is pressed into the face of the cloth. Another process of quite recent date produces a moiré effect by means of printing irregular surfaces with several opalescent colors irregularly overlapping each other. The former process (printing with engraved cylinders) always produces repeat in the design, while in the color printing the repeat can be avoided by using rollers with different diameters for the various colors.

Embossing. Embossing is an effect produced on goods by passing them through pairs of correspondingly engraved rollers. This is usually applied to thin goods, although embossed effects are produced on velvets by the pressure of a roller engraved in relief.

Silk Waste. When the cocoons are softened for reeling, a certain portion of the silk is found to consist of waste and broken threads. The tangled silk on the outside of the cocoon is called *floss*. The residue after reeling, and other wastes in reeling, are known as *frisonnets*. Floss silk is not used for weaving. It is a slack-twisted tram, generally composed of a large number of threads of singles.

Spun Silk. There is another class of threads made from waste silk by spinning and known as spun silk. Waste silks include the pierced cocoons, that is, those from which the moth has come out by making a hole and breaking the fibers in one end of the cocoon; the waste made in the filatures in producing raw or reeled silk, chiefly the outside fibers of the cocoon and the inside next the chrysalis; and also the waste made in manufacture. The waste silk is ungummed; that is, the gum is removed from the fibers by boiling with soap, by macerating or retting, or by chemical reagents. Since the fibers are small, they must pass through the same operations as cotton and wool in order to make a continuous thread. The reeled silk from the whole cocoon is continuous, and it is not necessary to card, comb, and spin it. Imported spun silk is called schappe silk and is used for the pile of some velvets.

After the gum is removed from the cocoons, they are opened and combed, most of the chrysalis shell being removed. The remainder, with other foreign matter, is picked out by hand from the combed silk. The silk is put through a number of drawing frames to get the fibers even on the roving frames, where it first takes the form of thread, then on the spinning frames, where it is twisted. If it is to be used as singles, the manufacture ends here. In two- or three-ply yarns, the singles are doubled, twisted again, singed by running through a gas flame, cleaned by friction, controlled, that is, the knots and lumps taken out, and then reeled into skeins for dyeing, or put on spools.

Spun Numbers. There are two methods in general use for numbering spun silk. In the French system, the number is based on the singles, by the meters per kilogram; two- and three-cord yarns have one half, one third, etc., the length the numbers indicate. Thus —

No. 100 singles has 100,000 meters per kilogram.

No. 2-100 has 50,000 meters per kilogram.

No. 3-100 has 33,333 meters per kilogram.

The other system, which is more generally used in this country, is the English system. The hank is 840 yards, and the number of hanks in one pound avoirdupois is the count of the yarn. It is based on the finished yarn, and singles, two- or three-cord yarns of the same number all have the same yards per pound. Thus —

No. 50 singles has 42,000 yards per pound.

No. 50-2 has 42,000 yards per pound.

No. 50-3 has 42,000 yards per pound.

Silk Ribbons. Silk ribbons are narrow, woven fabrics, with straight selvedges, not exceeding 12 inches in width. Imitation or cut ribbons are made from broad silks. Silk ribbons are made in many types, such as taffeta and grosgrain plain ribbons; single-faced satin ribbons; double-faced satin and grosgrain ribbons; two-toned satin ribbons with a different color on each face; and fancy Jacquard ribbons. They are known, according to their use, as sash ribbons, hair ribbons, neck ribbons, belt ribbons, etc.

Weaving Silk Ribbons. Silk ribbons are woven on ribbon looms. A number of separate ribbons, necessi-

tating numerous small shuttles, controlled by rack and pinion, are woven on each ribbon loom simultaneously. Silk ribbons over 8 inches wide are rarely in demand, and goods over 12 inches are classed as broad silks and made on a fly-shuttle loom.

Narrow Widths First Phase. The manufacture of narrow widths was almost the first phase of the silk industry, after the manufacture of sewing thread, to secure a strong foothold in the United States. The imports of silk ribbons are negligible as compared with the local production, and consist mainly of ribbons required in small quantities, so small that the expense of the frequent changes does not justify domestic mills in attempting to catch the trade. They are largely novelties including gold and other metallic thread ornamentation. St. Etienne is the main source of ribbon novelties, but there are smaller imports from Basel, and in normal times from Crefeld.

Quotations either French or English in Origin. Silk ribbon quotations are based on the *ligne* (of width) per bolt of ten yards. The ligne is one twelfth of the old French *pouce* (2.707 cm.), and is therefore equivalent to 0.0888 of an English inch. Ribbons are also numbered from No. 1 (baby ribbon) up to No. 100 or over. This numbering system was originally based on the thickness of the old English penny, which was nearly the size of our silver half dollar, but the system has been corrupted. Different manufacturers use the same numbers for different widths, and it has become the practice to use higher numbers on fine than on cheaper ribbons

of the same width. Above No. 22, or 30 *lignes*, the number is now only an approximate indication of the real width and is frequently little more than a fancy name.

Styles. Silk ribbon manufacturers are much affected by prevailing styles. When silk ribbons are not in vogue, a large proportion of the ribbon looms stand idle. Some are always idle, as looms must be kept to make ribbons of different widths and types, and the demand varies from season to season. Velvet ribbon, however, is an article subject to the vagaries of fashion, and at times manufacturers have to carry over heavy stocks. It is largely due to this fluctuating demand, and not to any special difficulty of manufacture, that comparatively few American firms make velvet and plush ribbons of silk, and that considerable amounts are supplied by foreign firms. Imports are of the two extremes, largely all-silk velvet ribbons of high grade, with a fair amount of the cheapest cotton-black schappe-pile ribbons.

Velvet Ribbons. Velvet and plush ribbons are made on ribbon looms, usually of the curved-shuttle type, but the method of manufacture is substantially the same as that used on broad looms for velvets. The ribbons are woven as two ground cloths connected by pile threads, which are then cut by a sliding loom-knife and each ribbon wound up separately. Velvet ribbons, being narrow fabrics, cost more per pound to produce than velvets, the cost of production increasing with the narrowness of the ribbon.

Sewing Silk, Machine Twist, Floss. The term sewing silk is generally confined to hand-sewing silk; this is made by winding and doubling the raw silk, giving it a hard twist, and doubling and twisting again in the reverse direction under a strong tension.

Machine twist is made in a way similar to that used in making hand-sewing silk, except that it is a three-ply instead of a two-ply thread. It is largely used for hand sewing as well as machine sewing.

Floss silk generally consists of a large number of singles, very slightly twisted. *Embroidery silk* consists of numerous slackly twisted singles, doubled and again slightly twisted in the reverse direction. These soft silk yarns, practically without twist, are used in making embroidery and other fancy work by hand; they are not adapted to machine use. This is due to the fact that when sewing machines were first introduced, the silk thread then made was not especially suited for use upon them. The shuttle of the machine did not always pass through the loop that was carried down by the needle, and hence a stitch would be dropped at intervals. At length, after many experiments, the discovery was made that this defect could be remedied by making the thread in a different way. This newly invented thread, which serves its purpose perfectly, was denominated "machine twist," and it still retains the name, which is sometimes abbreviated by dressmakers into "twist." There is a marked distinction between "sewing silk" and "twist."

Sewing silk, often designated simply as "sewing,"

consists of two threads twisted from left to right; that is, it has the twist of a right-hand screw. *Machine twist* is made from right to left, and is usually of a harder, closer twist than sewing. The latter may be put up either in skeins or on spools. Machine twist is always spooled. While sewing silk can not well be used for the sewing machine, twist can be employed for a great variety of purposes besides that for which it was devised. It has taken the place of sewing silk to a considerable extent, and this substitution is still going on in different manufactures. Merchant tailors and other makers of clothing are now almost the only users of skein silk.

Spool silk is put up in two great divisions: either as yard goods or as ounce goods. In general, the yard goods are sold by the yard irrespective of weight. These constitute the majority of the spools sold at retail by dry goods and fancy goods dealers. The ounce goods are sold by weight, which is stated on the spools in ounce and ounce fractions. The thread is mostly used for manufacturing purposes; and the makers of shoes, corsets, and clothing prefer silk thus put up, because it is on large spools that do not have to be frequently replaced, as do smaller ones, on the sewing machine.

Machine twist is made from the best grades of China and Japan raw silk. Sewing silk, for dressmaker's use, does not need to be as perfect, strong, or elastic as that for machine work, and is usually made from lower grade raw silk. Some sewing silk is made

from spun silk, but this lacks elasticity and is very inferior.

Retail stores buy thread in 100- and 50-yard lengths and spools, the big city stores requiring the longer lengths and the small country stores taking mainly the shorter length. Some silk thread, such as buttonhole twist, is put up on spools in 10-yard lengths. Manufacturers of clothing buy silk thread on spools containing one ounce each, or on cones containing from two to eight ounces, as desired. Owing to the variation in size of individual cocoon filaments, it is impossible to make silk thread exactly to size, and when sold by weight the length is never guaranteed except within wide limits.

Numbering Silk Thread. Arbitrary systems are used in numbering silk thread. For example, " 0000 " is any thread that runs above 1600 yards to the ounce; 00 thread runs 1200 to 1600 yards to the ounce; 0 thread runs 1000 to 1200 yards; A thread runs 800 to 1000 yards, etc.; down to FF, which is used for thread running 125 to 175 yards to the ounce, and G, which is used for anything under 125 yards to the ounce.

Artificial Silk. Examine a piece of genuine silk and of artificial silk. Note that the genuine silk is stronger and has a deep pearly luster, while the artificial silk is not so strong, and has a bright metallic luster.

The high price of silk has led to many attempts to find silk substitutes, either by improving the luster of natural fibers or by building up an entirely new artificial fiber. Success has been attained in both direc-

tions; in the first, by the process of mercerization of cotton yarns and cloth, already explained, and in the second by the production of artificial silk from wood pulp (cellulose) by chemical changes.

Artificial "silk" is not really silk at all, — in the sense that artificial indigo is chemically the same as purified indigo obtained from the plant, — and possesses hardly more than one of silk's distinctive physical properties. "Imitation silk" would be a more appropriate description.

Artificial silk was first produced on a commercial scale by Count H. de Chardonnet at Besançon, France, in 1885, but it was after many years' trial, during which much money was spent in experiments, and several companies failed before the products were perfected and the manufacture of these silk imitations was put on a sound basis. It was not until 1909 that artificial silk was considered a commercial product.

Sources of these Silks. These silks have been made from gelatin (vanduara silk), from casein (the solid constituent of cheese), and from glass, but all of the commercially important artificial silks are now obtained by using some form of wood or purified vegetable matter (cellulose) as a base. Cellulose is the predominating constituent of plant tissue; it is a very inert substance and does not yield readily to chemical attacks. Each of the main methods of dissolving cellulose forms the basis of a commercial process for manufacturing artificial silk. The most important are as follows:

(1) *Nitro-cellulose Silks.* These are also known as

pyroxylin silks and as collodion silks. Cellulose is first nitrated in a mixture of sulphuric and nitric acids, and after washing and drying, the pyroxylin thus prepared is dissolved in a mixture of ether and alcohol to form collodion. This solution, after filtering, is "spun" by being forced through capillary openings, as continuous gelatinous filaments which solidify as the vapors of alcohol and ether are evaporated into the air. As this product is very inflammable, it is denitrated with ammonium sulphide before use, and then slightly bleached to remove the yellow tinge thereby produced. The principal names connected with this are those of Chardonnet, the original inventor, and Lehner. It has attained greatest perfection in France and Belgium.

(2) *Cupra-ammonium Silks.* These are known in Germany, the leading center of their production, as *glanzstoff.* Cellulose is dissolved in an ammoniacal solution of cupric oxide (cupra-ammonium). This solution, after filtering, is spun into filaments, which are coagulated and the metallic salts removed by passing through a bath of acid or alkali, the latter being now most usual. The principal names connected with this process are those of Pauly, Linkmeyer, and Thiele.

(3) *Viscose Silks.* Cellulose is dissolved in strong alkali and carbon bisulphide, producing cellulose xanthate. This solution is treated with dilute caustic soda, and there is obtained a golden-brown thick sirup, to which its discoverers, Cross, Bevan, and Beadle, gave the name *viscose*, on account of its high viscosity. This viscose, after filtering, is spun into

filaments, which are coagulated by passing through a solution of ammonium sulphate. Although cellulose xanthate, the basis of the viscose process, was discovered in 1892, it was not until 1898 that Stearn developed the spinning process, and not until several years later that viscose silk was produced on a commercial scale.

Nitro-cellulose and cupra-ammonium silks are produced from cellulose which is usually obtained by purifying cotton waste or linter. Viscose silks are produced from cellulose obtained from wood pulp, the raw material usually being Norwegian spruce. These have the advantage of starting with a somewhat cheaper raw material and of being easier to manufacture. They can therefore be sold cheaper than either of the other two varieties, and viscose is tending to displace all other imitation silks except those required for special uses.

The general principle of the apparatus used in "spinning" artificial silk is simple, but there are many different designs which are continually being improved upon. The spinning solution, of the required consistency, is introduced into the spinning apparatus, a stout reservoir, and is then forced therefrom, by continuous air pressure, through a series of tubes.

Artificial silks are more lustrous than real silk, but are heavier, weaker, less elastic, and more difficult to manipulate. The price per pound is less than that of natural silk, though this is to a small extent offset by the fact that the specific gravity of artificial silk is about 10 to 20 per cent greater. One of the chief

drawbacks to its use in cloths has been its inability to withstand moisture, but some varieties, even of wood silk, have now been perfected so that they can be used in wash goods. The demand for artificial silk is steadily increasing, and there is apparently no limit to its possibilities. It is not impossible that in time the production of artificial silk may surpass that of natural silk.

Numbering Artificial Silk. Artificial silk is sized according to the raw-silk system, by the weight in deniers (0.05 gram) of a standard length of 450 meters. The counts most used in the American artificial silk trade are 130, 150, 250, 300, and 450 deniers, measuring 34,342, 39,763, 17,858, 14,882, and 9,921 yards to the pound, respectively.

Imports and Production. The importation of a new type of artificial silk should be noted. It comes in ribbon form, making braids, and is called "ribbon straw." The narrowest is known as *lame*, of which the kinky type is *lame frisee*. These ribbons, or lame, although flat, are made at the first process of manufacture and so, in the absence of any special provision, enter under the provision for "yarns, threads, and filaments of artificial or imitation silk."

Artificial Silk Fabrics and Articles. Artificial silk is yearly becoming of increasing importance; it is being produced in larger amounts and used in the manufacture of a continually increasing range of goods. It is no longer confined to the making of braids and dress trimmings, or to being used as stripes in cotton fabrics.

In the ribbon industry it is proving a serious competitor of silk. The knitting mills are making neckties, mufflers, shawls, and hosiery out of wood silk. It is used in hand and machine embroidery and is well adapted to the manufacture of the heavier laces. The electric industries utilize it for covering wires, on account of its insulating properties. In the incandescent mantle industry artificial silk has been found to offer marked advantages over both ramie and cotton and is being substituted for them. It is being used to a larger extent every year in the dress goods and shirting trade, in velvet and plush manufacture, and in the upholstery trade. Artificial silk has a different feel, and is inferior in strength, suppleness, and durability to silk, but now that its most marked defects have been eliminated or modified, it is becoming a factor of decided importance in the textile industry.

Artificial Horsehair. Artificial horsehair differs from artificial silk in that it is coarser and stiffer. It also differs in being produced and used in coarse single filaments and not, as in the case of artificial silk, in fine filaments which must be combined before being used. Artificial horsehair comes only in very coarse sizes, mainly the 300 and 600 denier, measuring 14,882 and 7,441 yards to the pound, respectively.

Selling Points of a Silk Fabric. Summarizing the qualities of silk, we find that:

1. Silk is an expensive fabric, due to care and expense in producing it.

2. It is warm, because it does not conduct the heat.

3. It is a light-weight fabric, because the silk is very strong and fine.

4. It sheds dirt and keeps clean, because the fibers are very smooth.

5. Silks are difficult to wash, due to the bad effect of friction and the action of soaps in deposits of liquids.

6. It is easily spotted, due to the delicate luster of the fiber.

7. It may be made heavy by addition of salts.

8. The fabrics hold their shape, due to the elasticity of the fiber.

9. Some silks will wrinkle and crease, due to weighty materials added.

QUESTIONS

1. Why is silk the most popular of all fabrics?
2. State the four divisions in the manufacture of silk.
3. What is sericulture? Why is it such an important part of the silk industry?
4. Describe the steps in the cultivating of raw silk.
5. Define the following terms: cocoon; whole cocoons; broken or pierced cocoons.
6. (*a*) How is raw silk bought and sold?
   (*b*) How is it shipped to this country?
7. Describe the method of obtaining raw silk from the cocoons.
8. (*a*) Describe some of the defects noted in raw silk.
   (*b*) How is the fineness of silk expressed?
9. Give briefly the history of silk.
10. How is raw silk used?
11. What is meant by "throwing silk"?
12. State the qualities of raw silk yarn; organzine yarn; tram yarn; crêpe yarn.
13. State the uses of each of the above yarns.

14. Why do we not card, comb, and spin raw silk the same as cotton and wool?

15. Describe the method of dyeing silk.

16. What is meant by the terms " weighting," " dynamiting," or " loading " silk?

17. Is such silk necessary and economical?

18. State some of the defects of " over-loading."

19. Describe the finishing operations of silk.

20. State the difference between " embossing " and " moiré."

21. What is done with the silk from the pierced or broken cocoons? With " waste silk"?

22. Why is it necessary to card, comb, and spin the waste silk from the whole cocoon?

23. Describe the method of manufacturing spun silk.

24. How is the fineness of spun silk expressed?

25. What is the difference between broad and narrow silks?

26. Describe the importance of silk ribbon.

27. How is the price of silk ribbon determined?

28. Mention several types of silk ribbon.

29. Distinguish between machine twist, sewing silk, and floss silk.

30. What is the system used in numbering silk thread?

31. (*a*) What substitutes have been used for genuine silk?

(*b*) Has a single substitute met the requirements of genuine silk?

32. (*a*) Compare mercerized cotton and genuine silk.

(*b*) Compare schreinerized venetian with genuine silk.

33. Why has artificial silk been offered to the market? How does it resemble genuine silk?

34. Compare between true and artificial silk the following: — (*a*) strength; (*b*) luster; (*c*) weaving qualities.

35. When was artificial silk discovered? What is its basic substance? How is it made?

36. How many methods are used for the making of artificial silk?

37. What are the uses of artificial silk?

38. What is artificial horsehair?

39. Has any improvement been made so that artificial silk will withstand dampness and increase its strength for weaving?

40. What are the selling points of silk?

CHAPTER XVII

NAMING SILK FABRICS

Silk fabrics are usually named by a compound word, one part of which represents the weave and the other the color or finish. For example, taffeta chiffon is the name of the fabric with a taffeta weave (plain) and a soft, lustrous finish (chiffon).

As the names of so many of the silk fabrics and of the colors in which they are made originate in France, the fabrics are better known by their French names than by their English equivalents. In fact, to give a silk fabric the French name often gives it an added selling value, for many people associate, not wisely, however, superiority with imported articles. The French names give the impression that the fabric is imported. Hence it is desirable to have a working knowledge of French terms and English equivalents of the colors and finishes of textile fabrics.

Names of Colors in French and in English.

(Silk Glossary — Cheney Bros.)

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Abesse	ab-ess	Dark purple	Abbes
Abricot	ah-bree-ko		Apricot
Absinthe	ab-sant	A dull green	Absinthe
Acajou	ah-cah-zhoo		Mahogany
Acier	ass-yay		Steel
Amande	ah-mande		Almond

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Amarante	ah-mah-rant	A purple color	Amaranth
Ambre	ongbr		Amber
Amiral	ah-me-ral	Dark navy	Admiral
Anguille	ong-gwee	Grey green	Eel
Ardoise	ard-was		Slate
Argent	ar-zhong		Silver
Argile	ar-zheel		Clay
Armeline	ar-mel-een		Ermine
Artichaut	ar-te-sho	Dark green	Artichoke
Asphodèle	as-fo-dehl	A bright yellow	Daffodil
Aubergine	o-ber-zheen	Dark reddish purple	Egg-plant
Beige	bayzh	A yellowish cream	Natural wool color
Biche	beesh	Fawn color	Hind
Blanc	blong		White
Blé d'or	blay dor		Golden grain
Bleu	bleu		Blue
Bleu de cadet	bleu de kah-day	Grey blue	Cadet blue
Bluet	bloo-ay	A bright greyish blue	Corn-flower
Bordeaux	bor-do	Color of the wine	Claret
Brun	brun		Brown
Bourgogne	boor-goyne	Color of the wine	Burgundy
Café	cah-fay		Coffee
Caméléon	kam-ay-lay-own	Changing in color	Chameleon
Campanule	camp-an-ool		Blue-bell
Canari	can-ah-ree		Canary
Cannelle	can-nell		Cinnamon
Capucin	cap-oo-san	Brown	Capuchin (Monk)
Capucine	cap-oo-seen	Orange red	Nasturtium
Cardinal	card-in-al	Deep rich red	Cardinal
Carné	Car-nay	A bright pink	Carnation color
Cassis	cas-see	A blackish purple	Black-currant
Castor	castor		Beaver
Cèdre	sehdr	Dark green	Cedar
Cendre	sawndr		Ashes
Cendres de roses	sawndr de rose	A pale dull pink	Ashes-of-roses
Céramique	say-ram-eek	Porcelain blue	Ceramic
Cerise	sair-ees		Cherry
Champagne	sham-pain	Color of the wine	Champagne

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Champignon	shong-peen-yong		Mushroom
Chardon	shar-dong	A purple	Thistle
Chasseur	shas-soor	Dark green	Hunter
Ciboulette	seeboolette	Bright green	Chive
Ciel	see-el		Sky
Citron	see-trong		Lemon
Clochette	clo-shet	Thè blue-bell	Bell-flower
Cochenille	coash-neel	Carmine red	Cochineal
Cognac	coan-yac		Brandy
Colombe	col-omb	Light grey brown	Dove
Concombre	con-congbr		Cucumber
Copenhague	co-pen-hague	A shade of porcelain blue	Copenhagen
Corail	cor-ai		Coral
Corbeau	cor-bo		Raven
Cornaline	corn-ah-leen	A deep flesh red	Cornelian
Corneille	cor-nay		Crow
Cramoisi	crong-was-ee		Crimson
Crème	crehm		Cream
Cresson	cres-song	Yellow green	Water-cress
Crevette	crev-et	Yellow pink	Shrimp
Cuir	queer		Leather
Cuivre	kweevr		Copper
Damas	dah-mah	Dark plum color	Damson
Demi-deuil	demy-dweuh	Very dark purple	Half-mourning
Dent-de-lion	dong-de-leon		Dandelion
Ecarlate	ay-car-laht		Scarlet
Emeraude	ay-meh-ro		Emerald
Eminence	ay-man-ongce	Deep red	A church dignitary
Emir	ay-meer	Bright green	Emir
Empire	ong-peer	Full green	Empire
Evêque	ay-vehq	Purple	Bishop
Faon	fah-on		Fawn
Fer	fair	Very dark grey	Iron
Feu	feuh		Fire
Feuille-morte	feuhe-mort	Pale brown	Withered leaf
Flamant	flah-mong	Bright pink	Flamingo
Flambe	flongb		Yellow water-flag

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Fraise	frays		Strawberry
Framboise	frong-bwas		Raspberry
Fuchsia	foo-shah	A bluish red	Fuchsia
Fumée	foo-may		Smoke
Garancine	gah-ran-seen	Turkey red	Madder red
Gazon	gah-zong		Grass
Gendarme	zhong-darm	Military blue	Armed policeman
Genêt	zhen-ay	Light dull green	Broom
Géranium	zhay-ran-ee-um	Scarlet red	Geranium
Glaïeul	gly-euhl	A purple flower	Iris, Gladiolus
Grenat	gren-ah		Garnet
Gris	gree		Grey
Gris d'anguille	gree don-gwee	Greenish grey	Eel-grey
Gris de cadet	gree de cah-day	A blue grey	Cadet-grey
Gris de fer	gree de fair		Iron-grey
Gris de perle	gree de pairl		Pearl-grey
Groseille	gro-saih	A dull red	Gooseberry, Currant
Homard	ho-mar	Bright red	Lobster
Hortensia	or-tonn-see-ah	A lilac shade	Hydrangea
Huître	weetr	Oyster white	Oyster
Hussard	hoo-sar	Cadet blue	Hussar
Incarnat	an-car-nah		Carnation-red
Isabelle	ees-ah-bel	A light brownish yellow	Isabelle
Isard	ee-zar	A grey color	Wild-goat
Ivoire	ee-vwor	Cream	Ivory
Jais	zhay	Dead black	Jet
Jaspé	zhas-pay	Black and white mixed	Jasper
Jaune	zhoan		Yellow
Kermès	ker-mehs	Venetian scarlet	Kermes
Khaki	kah-kee	A yellow brown (from Hindustani word for earthy); name is also applied to the strong cotton fabrics made in this color	Khaki

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Laitue	lie-tew		Lettuce
Laurier	loar-yay		Laurel
Lavande	lah-vahnd		Lavender
Lézard	lay-zar	Bright green	Lizard
Lichen	lee-ken	Grey green	Lichen
Lie de vin	lee de van	A dull claret color	Dregs of wine
Lierre	lee-air		Ivy-like
Lilas	leel-lah		Lilac
Lis	lee		Lily
Livrée	lee-vray	Coachman's buff	Livery
Loriot	lo-ree-o	Orange red	Oriole
Magenta	mah-gent-ah	A purplish red (after the Battle of Magenta)	Magenta
Maïs	mice	A light yellow	Maize
Malachite	mah-lah-keet	A rich green	Malachite
Mandarine	man-dar-een		Mandarin-orange
Marine	mah-reen	A shade of navy blue	Marine
Marjolaine	mar-zho-lain	A purple flower	Marjoram
Marron	mah-rong	Red brown	Chestnut
Matelot	maht-lo	A shade of navy blue	Sailor
Mauve	Mohv	A reddish pink	Mallow
Mélange	may-longzh		Mixture
Melon d'eau	meh-lon doh	Pink	Watermelon
Menthe	maunt		Mint
Mercure	mare-cure	A grey, like quicksilver	Mercury
Métal de canon	may-tal de cah-nong	Bronze color	Gun-metal
Miel	mee-el		Honey
Mordoré	maur-doh-ray	A bright reddish-brown	Literally "Rusted Gold"
Mousse	moose	Dull grey green	Moss
Moutarde	moo-tard		Mustard
Mûre	moohr	A purplish black	Mulberry
Myrte	meart	Dark green	Myrtle
Nacarat	nah-cah-rah	Orange red	Nacarat
Nacre	nahcr		Mother-of-pearl
Napoléon	nah-po-lay-ong	Bright navy blue	Napoleon
Narcisse	nar-sees	Bright yellow	Narcissus

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
National	nash-yon-al	Dark navy blue	National
Nil	neel	Pale green	Nile
Noir	nwor		Black
Œillet	wee-yay		Carnation pink
Olive	o-leev		Olive
Or	or		Gold
Orange	o-rongzh		Orange
Orchidée	or-kee-day	A light purplish color	Orchid
Paille	pai		Straw
Paon	pah-on	Bluish green	Parrot
Parme(Violettes de parme)	vee-o-let dĕ parm	Deep violet	Parma violet
Passe-fleur	pass fler	A pinkish red	Hollihock or rose-mallow
Passe-rose	pass rose	Pale rose	Rose-mallow
Pavot	pah-vo	A brilliant red	Poppy
Pêche	pehsh		Peach
Pensée	pon-say	A bluish purple	Pansy
Perle	pairl	A very light grey	Pearl
Perroquet	pehr-o-kay	Bright green	Parrot
Persil	per-see		Parsley
Pervenche	per-vongsh	Violet blue	Periwinkle
Pistache	pees-tash	A soft green	Pistachio
Pivoine	pea-vwon	A very deep red	Peony
Plomb	plong	A dull grey	Lead
Ponceau	pon-so	A brilliant red	Poppy-colored
Porcelaine	por-see-lan	Delft blue	Porcelain
Pourpre	poorpr		Purple
Praline	prah-leen	A pinkish brown	Burnt-almond
Prélat	pray-lah	Purple	Prelate
Primevère	preem-vair	A soft yellow	Primrose
Prune	proon		Plum
Pruneau	proo-no	Very dark plum color	Sloe
Prunella	proo-nel-lah		Prune
Puce	poos	A pinkish brown	Flea
Raiponce	ri-ponce	A pale blue	Rampion
Raisin	ri-zan	Raisin color	Grape

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Ratine	rah-teen	A fine red color	False-poppy
Ravenelle	rah-ven-elle	Rich yellow brown	Wall-flower
Réséda	ray-zay-dah	A green, like the mignonette leaf	Mignonette
Rhododendron	ro-do-den-dron	A bluish pink	Rhododendron
Rose feuillée	rose feuh-yay		Rose-leaf
Rose incarnat	rose an-car-nah		Damask-rose
Rose laurier	rose loar-yay		Laurel-rose
Rose sauvage	rose soh-vazh		Wild-rose
Rose trémière	rose tram-yair		Rose-mallow
Roses écrasées	rose ay-crah-say		Crushed roses
Rouge	roozh		Red
Rouge foncé	roozh fong-say	Liver color	Deep brownish-red
Rousse	roos		Russet
Royale	roy-ahl	Bright, full blue	Royal
Rubis	roo-be		Ruby
Safran	sah-fran	Deep yellow	Saffron, Crocus
Sang	song		Blood
Sang de bœuf	song dĕ beuf	Deep rich red	Ox-blood
Sang de dragon	song dĕ drah-gong	Deep rich red	Dragon's blood
Sang de pigeon	song dĕ pee-zhong	Deep rich red	Pigeon's-blood
Saphir	sah-fear	A bright blue	Sapphire
Sauge	soazh	An olive green	Sage
Saumon	so-mong		Salmon
Sépia	sayp-yah	The dark brown fluid secreted by the cuttle-fish	Sepia
Serpent	ser-pong	A bright green	Serpent
Serpolet	ser-po-lay	Dark sage green	Wild-thyme
Soldat	sol-dah	The scarlet color used in French uniforms	Soldier
Solférino	sol-fer-ee-no	A purplish rose (named after the Battle of Solferino)	Solferino
Souci	soo-see	An orange yellow	Marigold
Soufre	soo-fr	Bright yellow	Sulphur
Souris	soo-ree	A full grey	Mouse

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Tabac	tah-bac		Tobacco
Taupe	tohp	A dark brownish grey	Mole
Terre glaise	tair glaiz	A whitish grey	Fullers' earth
Thé	tay		Tea
Thym	teem	A dull dark green	Thyme
Tournesol	toorn-sol	Golden yellow	Sunflower
Tussah	tus-sah	The brown color of wild silk	Tussah
Veau marin	vo meh-reen	A rich brown	Seal
Verde antique	vaird an-teek	Similar to oxydized copper	Ancient-green
Verdet	vair-day	A bright bluish-green	Verdigris
Vert	vair		Green
Verveine	ver-vain	Violet red	Vervaine
Vieil or	vee-ay-or	A deep dull yellow	Old-gold
Vin	van	Claret color	Wine
Violette	vee-o-let		Violet
Violettes de parme	vee-o-let dĕ parm	Dark violet	Parma violets
Zibeline	zib-el-een	The brown color of the sable	Sable

Names of Characteristics or Finish of Fabrics in French and English.

Abbatre	ab-at-ray	Applied to patterns with depressed effects	Depressed — sunken
A jour	ah zhoor	Open-work effects	"Today — to the day," as "exposed to the day"
Appliqué	ap-lee-kay	As designs made by stitching braiding on the garment	Applied — laid on
Apprêt	ap-pray	The sizing or dressing applied to goods	Finish — dressing

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Barré	bah-ray	Effects of a cross-over stripe character	Barred
Bayadère	by-ad-air	Broad and lively cross stripes	Bayadere
Borduré	bord-oo-ray	Describes goods with a woven or printed border pattern	Bordered
Bosselé	bos-el-ay	Patterns made by embossing	Embossed
Bouclé	boo-clay	Applied to goods in which are novelty yarns showing curly loops	Curled
Bouillonné	boo-yon-nay	A shirred or rippled effect	Shirred—gathered
Bourré	boo-ray	Effects where the pattern has a stuffed or waded character	Stuffed
Boyau	boy-o	A stripe, or edging, of a cord-like character	Pipe — hose
Brillant	bree-yong	Shiny. This name is given to a chiffon-like fabric made of untwisted raw silk	Bright
Brillanté	bree-yon-tay	Something very iridescent	Glittering
Broché	bro-shay	Showing a certain kind of figured effect	Figured—stitched
Brodé	bro-day	Figured in a manner similar to embroidery	Embroidered
Broderie	bro-dè-ree		Embroidery
Camaieu	cam-ah-yeu	Made with different shades of the same color	Cameo
Caméléon	kam-ay-lay-ohn	A three-tone glacé effect	Chameleon, a lizard that changes color

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Canille	can-eel	A jointed effect, with stripes broken at intervals by knots or small squares, like a bamboo effect	Cane-like
Cannelé	can-el-lay	Narrow fancy broken stripings	Fluted
Carré	cah-ray	Checkered effects	Squared
Carreau	cah-ro	A check, or block	Square
Changeant	shong-zhong	Shot effects, as from contrasting colors	Changeable
Charmant	shar-mong	Used when something is specially dainty	Charming
Charmeuse	shar-meuz	Applied to a certain rich piece-dyed fabric. A crêpe-warp satin	Charmer
Chenille	shen-eel	Velvety silk-cord	Chenille (Fr.) — A caterpillar
Chiné	she-nay	Blurred, soft, indistinct, as a warp-printed effect	Colored — tinged
Clarté	clar-tay	Clear in outline, well defined	Clearness
Coloré	co-lo-ray	Colored by dyeing or otherwise	Colored
Coquillé	co-kee-yay	Made with scalloped patterns or edges	Shell-like — scalloped
Côtelé	co-tel-lay	Having distinct ribs or wales	Ribbed
Craquelé	crahq-lay	Effect like crackled glass	Crackled — lace-like
Crepé	creh-pay	Made with crapy effect	Craped
Croisé	crwoz-ay	Applied to a velvet weave, with a twilled back	Twilled
Damassé	dam-as-say	Figured brocade	Damasked
Damier	dam-yay	A checker-board	Patterns of large squares

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
De luxe	dĕ looks	Something superlatively fine	Of luxury
Dentelé	don-tel-lay	Applied to certain kinds of edges	
Dentelle	don-tell	Open work, lacey effects	Lace-work
Deux tons	deu tong	Warp and filling of contrasting colors	Two-tone
Ecossaise	ay-cos-says	Scotch tartan patterns	Plaid (Scottish)
Ecrasé	ay-crah-say	A pattern with a crushed or flattened effect	Crushed
Epinglé	ay-pang-glay	Largely applied to fabrics having ribs of alternating sizes, or colors	Corded
Exquis	ex-quee	Of the highest character	Exquisite
Façonné	fah-son-nay	Applied to Jacquard figured fabrics	Wrought — figured
Fantaisie	fan-ta-zee	Novelty effect, or specially high quality	Fancy
Festonné	fes-ton-nay	Applied to certain kinds of edges	Scalloped
Feutré	feu-tray	Used to describe the furry backs on some satins	Felted
Floconné	flo-con-nay	Fabrics in which appear flakes or tufts or contrasting colors	Flaky
Foncé	fon-say	Thus "rouge foncé" is liver colored	Deep-colored
Gaufré	go-fray	Patterns produced by pressure between engraved rollers	Embossed

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Glacé	glah-say	Applied to two-tone colorings	Frosted — ice-like
Granité	gran-ee-tay	Small granular patterns	Granite-like
Grisaille	greaze-eye	A black-and-white mixed effect	Grizzled
Grivelé	greeve-lay	A spotted or mottled effect	Speckled
Imprimé	ong-pree-may	Any printed effect	Printed
Lancé	lon-say	Applied to special-picks used for effects	Shot
Lumineux	loo-min-eu	Showing glints of color through the ground	Luminous
Lustré	loos-tray	Finished with special brilliancy	Lustered
Matelassé	mat-las-say	A figured effect, well stuffed out	Quilted — stuffed
Mat	maht	Flat, dull finishes or weaves	Lusterless — dead
Métallique	may-tal-leek	Applied to high luster effects	Metallic
Moiré	mwar-ay	Watered effect of many kinds	Watered
Monochrome	mon-o-chrome	Different shades of the same color	Single-colored
Monotone	mon-o-tone	Single-color effects	Monotonous
Nacre	nakr		Mother-of-pearl
Nacré	nah-cray	Iridescent, pearly effects	Nacreous
Natté	nat-tay	Small basket-weaves	Plaited — mat-like
Nouveauté	noo-vo-tay	Applied to anything new	Novelty
Ombré	ong-bray	Showing graduations of color	Shaded

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Ondé	on-day	Having a wavy, watered effect	Waved
Ondulé	on-doo-lay	Stripes of an undulating character	Undulated
Orné	or-nay	Specially ornate or decorated	Ornamented
Ouvré	oo-vray	Figured, stitched or embroidered	Worked
Pailleté	pi-yet-ay	Showing small, glittering effects	Spangled
Paillette	pi-yet		Spangle
Panaché	pan-ah-shay	Showing birds, flowers, fruits, leaves, etc.	Variegated
Passé	pas-say	Anything out of style	Passed — out of fashion
Peluché	pel-oo-shay	A rough, plush-like effect	Shaggy
Percé	pair-say	A kind of open-work effect	Perforated
Petits pois	pet-ee pwah	Small dots, as peas	Small dots
Picot	pee-co	A looped arrangement for edgings	Purl — loop
Plissé	plee-say	Showing alternate stripes, smooth and puckered	Pleated
Pointillé	pwong-tee-yay	Having a pattern with small points or dots	Dotted
Quadrillé	cad-ree-yay	Patterns of a squared kind	Checkered
Rayé	ray-ay	A general name for stripings	Striped
Relevé	rel-ev-ay	Figures showing in strong relief	Raised — in relief
Renversé	rong-ver-say	Patterns which reverse	Reversed
Repoussé	reh-poo-say	Patterns of a raised character	Pushed-back — bulked-up

FRENCH	PRONUNCIATION	DESCRIPTION	ENGLISH
Revers	reh-vair	Turned round	Reverse-side
Rondé	ron-day	Figures of a rounded shape	Rounded
Rongeant	rong-zhong	As a pattern made by eating out the design	Corroding
Scintillé	san-tee-yay	Brilliant and scintillating	Sparkling
Serpentin	sehr-pon-tan	Undulating striped effects	Spiral — winding
Serré	sehr-ay	Compactly pressed	Pressed
Soutache	soo-tash-ay	Effect of braidings on cloth	Braided
Tacheté	tash-tay	Having a speckled effect	Spotted
Teint	taint	Dyed; stained; tinged with color	Dyed
Travers	tra'.-vaihr	Cross-over effects	Across
Traversé	trah-vair-say	Crossed by stripes in the filling	Traversed — crossed
Velouté	vel-oo-tay	Soft, velvety and free from harshness	Velvety
Velu	vel-oo	Rough faced and hairy	Hairy

QUESTIONS

1. How are silk fabrics named?
2. Why is France the most important silk country?
3. Will a French name given to a textile fabric of silk add to its selling points? If so, why?
4. Give the English equivalent for the following:

Plissé	Glacé	Charmeuse
Moiré	de Luxe	Appliqué
Cerise	Chenille	Paille
Metallique	Pailletté	Noir

5. Give the French equivalents for the following English colors and finishes:

Embroidered	Metallic	Blue
Ornamented	Sable	Shaded
Silver color	Embossed	Figured
Novelty	Gun metal	Carnation red
Sparkling	Dotted	Checkered

PRINCIPAL SILK FABRICS

Agra Gauze (Eng.); **Gaze d'Agra** (Fr. pr. *gahz da-grah*). A gauzy silk fabric, strong and transparent.

Alba Velvet. Jacquard velvet.

Algerian Silk. Cotton warp frissons. A coarse, rough silk.

Alma. A cloth, double twilled from left to right diagonally, first made in black only as a mourning fabric. The name is from the Egyptian, as applied to a mourner or a singer at a funeral.

Armoisine (Fr. pr. *arm-was-een*); **Armozeen, Armozine** (Eng.). A kind of taffeta or plain silk used for women's and men's wear in the eighteenth century and earlier.

Armour (Eng.); **armure** (Fr.). The name given to small ridgy patterns, like bird's eye, pebble, diamond, etc., or patterns similar to chain armor. "Armure" is the ancient regular spelling of "armor."

Baronet Satin. A fabric of an exceedingly high luster, made of artificial silk and cotton, and used for summer wear. While it is not guaranteed as washable, with care it may be washed. As artificial silk takes dye very

easily, there are a number of brilliant shades in baronet satin. On account of the way it is woven, — satin weave with its long floats, — baronet satin pulls and catches if rubbed against a rough surface, and becomes shabby unless great care is taken.

Bandanna or **Bandana.** (From Hindustani, to bind, or knot, before dyeing.) A large handkerchief, dyed blue, yellow, or red, with small spots left white where the fabric has been tied to prevent it from receiving the dye.

Barathea or **Barrathea Cloth.** A silk of English origin, originally made plain or twilled. A cloth in which short broken ribs alternate, so as to produce a coarse granulated effect.

Barege. A sheer material of silk and wool, used for veiling; named from the town of Barèges, in France.

Batiste. A silk batiste, sheer, and diaphanous. Plain or figured; sometimes woven with small dotted effects.

Bengaline. An imitation of an old silk fabric made for many centuries in Bengal, India, whence the name. The weave is similar to that of ordinary rep or poplin, being a simple round-corded effect. The cord is produced by using a heavy soft-spun worsted filling, which is so closely covered by the silk warp threads that it is not exposed when examined from the wrong side. The same weave is also found in all-silk goods, under the designation of all-silk bengaline. When cheapened by the use of a cotton weft in place of wool, the fabric is known as cotton bengaline, although the cotton is in the filling only.

Bengaline Radiant. A fancy bengaline having a soft and heavy filling with a surface which reflects the light in points.

Berber. A satin-faced fabric of light-weight cloth. It came into favor about the time of the defeat of the Berbers by General Gordon in his campaign against the Mahdi in North Africa.

Biretz. A double-faced reversible fabric of silk and wool; one side a corded weave, and the other a cashmere or twilled weave. Sometimes called "electoral cloth."

Bluteau. A linen, hair, or silk cloth of which bolters are made for sifting flour, etc. It has an open mesh, and must be the acme of perfection and regularity.

Bombasine, Bombazine (Eng.); **Bombasin** (Fr. from *bombyx*, the silkworm moth). In modern usage, a fabric in which the warp is silk and the weft worsted. It is used largely for mourning hatbands.

Brillante (Fr. pr. *bre-yont*, brilliant). A light, sheer, piece-dyed fabric, made of raw silk in warp and filling. Very brilliant, but "slips" very easily. Principally used for millinery work.

Brocade (Eng.); **Brocart** (Fr. pr. *bro-car*). A silk fabric showing raised patterns of flowers, foliage, or other ornament, often enriched with gold and silver; also applied to other fabrics wrought and enriched in like manner. Most Jacquard figured goods of fair quality are now called brocade.

Brocatel (Eng.); **Brocatelle** (Fr. and Eng.). An all-silk brocaded material, used for curtains, furniture

coverings and the like. Sometimes the design has raised wool figures on a silk ground.

Cachemire de Soie (Fr. pr. *cashmeer de swah*, cashmere silk). A very high grade taffeta, or a fine twill finished to look like cashmere fabric.

Chenille. A cloth of a fuzzy or fluffy face; woven of cotton, silk, or wool; used sometimes for dress goods, more generally for curtains and table covers. Chenille is the French word for a caterpillar, which the single thread of the cloth resembles. The filling is chenille yarn, while the warp is worsted or cotton.

Chevreau de Soie. A piece-dyed, all-silk grosgrain with crêpe filling.

Chiffon. A thin, transparent silk muslin. Although one of the thinnest and gauziest of modern silk fabrics, it is relatively strong, considering its lightness. To convey an idea of the fineness of the thread used in its manufacture, it is stated that one pound of it will extend a distance of eight miles. In the process of finishing, the fabric receives a dressing of pure size. There are two styles of finish, called respectively the demi-, or half-size, and the full size. Chiffon finished by full sizing is comparatively stiff; while the demi-finish produces a softer and lighter texture. It is piece-dyed in a great variety of colors, and sometimes is printed in delicate patterns. The warp and filling are composed of hard-twisted singles. It is especially adapted for home and evening wear, and is used for neck and sleeve trimming, drapery over silk foundations, fancy work, and millinery.

Chiffon Taffeta (Fr.). A taffeta of good quality with a lustrous finish.

Chiffonnette (Taffeta), (Fr. pr. *sheef-on-et*). A soft pure-dyed silk.

China Silk. A term applied to plain woven silks manufactured in China. The term China silk has been adopted in the United States in recent years for a class of machine-woven silks made in imitation of the hand-loom product, with imperfection. These imitations are narrow in width and lack the soft, lustrous quality of the Eastern fabrics, and are also free from the uneven threads. China silks are distinguished by their irregular threads, caused by some of the threads being heavier than others, and by their extreme softness. The warp and filling are identical in size and color, and being woven evenly, produce a beautiful natural luster. It is generally plain color, although the figured goods are printed in much the same manner as calico. It is used for gowns, waists, underclothing, etc. It launders as well as white cotton. China pongee is considered a China silk.

Chirimen (Jap.). A Japanese silk crêpe.

Colonial Velour. A linen and cotton velour.

Cora, Corah (East Indian, meaning new or plain, as silk undyed). An India pattern silk handkerchief. Corah silk — a light silk, from the East Indies, washable, of creamy white color.

Corean Silk. A piece-dyed doppioni, medium weight, double cocoon filling.

Corset Cloth. A heavy satin, often with swiveled figures, used for corset covers.

Côte de Cheval. A material having a grosgrain effect broken at intervals with a short step, so as to produce a striped appearance slightly rounded.

Cotele. A very heavy ribbed silk, usually not more than 10 or 20 ribs to the inch.

Crêpe (Fr.); **Crape** (Eng.); (Latin, *crispus*, curled). A thin, gauzy fabric, woven in loose even threads of silk, heavily sized or gummed, crimped or crêped in the dyeing. Crêpe was first used in black only as a badge of mourning. It is now an accepted dress fabric, made in colors and white, and of many materials. The name signifies to crimp or crêpe with a hot iron. There is a wide variety of fabrics of this class on the market.

Crêpe Algerian. A pongee with a rough filling; printed, having a crêpy surface.

Crêpe Berber. A piece-dyed pongee with a rough filling, giving a crêpy surface.

Crêpe Charmeuse (Fr. pr. *crehp sharmeuz*, charming crape). A rich, soft, droopy, piece-dyed fabric with dull luster and glove-like feel. Properly made with grenadine silk for warp and crêpe twist for filling, and with a satin weave. It is used for dresses, waists, evening coats, and capes. It is desirable because it lacks the stiffness and body characteristic of satin, and therefore drapes more easily, and falls in softer and more graceful folds.

Crêpe Canton. A silk crêpe made with a fine warp and a heavier filling, alternating right-hand and left-hand every two picks, forming cross ribs. It is a heavier fabric than crêpe de Chine and has a fairly high luster.

Crêpe Chenette. A strong pebbled-surface crêpe.

Crêpe de Chine. A piece-dyed fabric with raw or thrown silk warp and with the filling of alternating twists of hard-twist tram. It is smooth and lustrous and has a fine crinkled effect. It is smoother than any of the other varieties of crêpe. It may be dyed almost any color, and launders well. It is used for dresses, waists, underwear, kimonos, men's shirts, etc.

Crêpe Diana. A cotton and silk warp crêpe.

Crêpe Jersey. A crêpe with ribs running the length of the goods.

Crêpe Faille Sublime. An all-silk, heavy grosgrain with a very hard-twisted filling.

Crêpe Georgette. A very light, sheer fabric with a fine crêpe surface. It is closely woven in a plain weave, with alternate right-hand and left-hand twists in both warp and filling. It is used for dresses and waists.

Crêpe Lease. A very light, open material, made with crêpe warp and filling, similar to veiling.

Crêpe Lisse (Fr. pr. *crehp lease*, smooth, lissom crêpe). A very light, diaphanous, and glossy crêpe.

Crêpe Météore (Fr. pr. *crehp maytay-ore*, meteor crêpe). A lustrous silk crêpe, with fine twill face. Crêpe meteor is a light-weight material, of a soft, firm texture. It drapes well and has a beautiful finish, but lacks the high luster of satin. It is used for dresses, waists, and men's ties.

Crepela (Fr. *crehp-lah*). A small crêpe-like effect.

Crepenette. An all-silk, piece-dyed, crêpy pongee.

Crêpon (Fr. pr. *cray-pong*, thick crape). A strongly

crinkled fabric, wool, or silk, or mixed wool and silk.

Crinkled Crêpe. A light satin-faced crêpe having a wrinkled or crinkled face.

Crystal Bengaline. A heavy bengaline.

Crystalline, Crystal. Corded fabrics with worsted filling, similar to bengaline.

Damask (Eng.); **Damas** (Fr. pr. *dahmah*). A figured silk, with figures and ground of contrasting weaves, usually made with satin ground, Jacquard figured. The name was first applied to fabrics made in Damascus.

Double Plush. A plush having a pile on both sides.

Drap d'Été (Fr. pr. *drah day-tay*, cloth of summer). Applied to fabrics of light weight and suitable for summer use.

Drap de Lyon (Fr. pr. *drah de leey-on*, cloth of Lyons). A rich quality of plain silk woven in Lyons.

Drap d'Or (Fr. pr. *drah dor*); **Cloth of Gold** (Eng.). A fabric heavily interwoven with tinsel, giving it a golden effect.

Drap de Soie (Fr. pr. *drah de swah*, cloth of silk). A fairly heavy all-silk, serge weave fabric, made in skein dyed and piece dyed.

Duvetyn de Soie (Fr. pr. *doo-vetyeen de swah*, from *duvet*, down, fluff). A heavy fabric, made from spun silk, napped to resemble plush.

Eolienne. A sheer cloth of silk, silk and wool, or silk and cotton, woven in fine card effect. The name comes from the Greek Aeolus, god of the winds.

Epinglé (Fr. pr. *ay-pan-lay*, pinned, as if woven over pins or wires). A firm cross-ribbed fabric, extensively used for tie silk. Sometimes it is woven with single cords at regular intervals, and sometimes there are two or three cords at uneven distances apart.

Epongé (Fr. pr. *ay-pong-zhay*, sponge). A thick sponge-like tissue, used for dresses.

Etamine (Fr. pr. *ay-tah-meen*, bolting cloth). An open mesh plain fabric, used for dresses, woven with doups.

Faille (Fr. pr. *fy-e*, fishing net). A good plain silk of the grosgrain order, but soft and with flat ribs.

Faille Française (Fr. pr. *fy-e frong-saize*, French faille). A faille as made in France with two or more picks in a shed, held in position by a special binder warp.

Faille Velour. Crêpe faille or grosgrain.

Failletine (Fr. pr. *fy-e-teen*). A light and soft woven faille.

Fillet de Bruxelles (Fr. pr. *fee-lay de Brussel*); **Brussels Net** (Eng.). A net of silk or cotton with a six-sided mesh, usually of small size.

Fleur de Soie (Fr. pr. *fleur de swah*, flower of silk). A silk with a satin de Lyon face and a 12-shaft satin back.

Florentine. A decorative fabric; a light spun-silk filled pongee.

Foulard (Fr. pr. *foo-lar*, silk handkerchief). A soft, light fabric made for printing or piece dying. Originally made for handkerchiefs only. It is used for dresses, linings, etc., and wears well. Largely made in two-and-

two twill, as well as in other weaves. The designs are large or small, according to the style.

Futako-cri (Jap.). A Japanese fancy cotton fabric, with a little silk used in it for effect.

Gaze (Fr. pr. *gahz*); **Gause** (Eng.). A thin, light voile-like fabric, made with hard-twisted silk woven with doups. (The French is from Gaza in Palestine.)

Geisha Silk. Piece-dyed habutae.

Georgian Crêpe. An armure.

Georgian Velour. A linen velour.

Glacé. Plain, lustrous silk, yard dyed, with warp of one color and weft of another. The name is applied to all fabrics having two tones. Glacé is French for *icy*, having an icy appearance.

Gloria. A durable plain weave cloth with silk warp and worsted filling, used for umbrella covers. Cotton filled glorias are also made.

Gossamer. A very soft and cobwebby silk gauze, used for veilings.

Granite Weave. A pattern of small, irregular character, like granite.

Grenadine, American. A coarse, heavy grenadine, plain or figured.

Grenadine, French. (English, wrought silk for making lace.) An open-work gauze-like silk fabric, plain or figured, woven with doups and generally stiff finished. Grenadine may also be made of worsted or cotton.

Grissaille. A material made with warp and filling contrasting black and white, giving a grey effect.

Grosgrain (Fr. pr. *gro-gran*, coarse grain). A heavy-ribbed, plain weave silk fabric for dresses. Ribs vary from about 50 to 70 per inch.

Gros des Indes (Fr. pr. *gro daysand*, gros [grain] of India). A silk dress fabric with a broad diagonal weave.

Gros de Londres (Fr. pr. *gro de londr*, gros [grain] of London). A cross-ribbed dress silk, with heavy and fine ribs alternating, or ribs of two different colors.

Gros de Lyon (Fr. pr. *gro de lee-on*, gros [grain] of Lyons). A skein-dyed fabric showing a coarse cross rib effect.

Gros de Naples (Fr. pr. *gro de nahpl*, gros [grain] of Naples). A fabric like taffeta luster, but not so smooth.

Gros de Paris (Fr. pr. *gro de pahree*, gros [grain] of Paris). Similar to Gros de Londres.

Gros de Tours (Fr. pr. *gro de toor*, gros [grain] of Tours). A rich, heavy, ribbed silk, soft but firm, with pronounced cords.

Habutae (Jap., meaning "soft as down"). A Japanese fabric of pure silk, made (not thrown or twisted) in plain, close weave. It is woven with a heavy sizing on both warp and filling, which is afterwards boiled out. The goods are usually piece dyed or printed.

Henrietta Cloth. A widely used twilled fabric with a silk warp and worsted filling, dyed in the piece. This cloth makes a comparatively warm but light weight garment. It is generally woven on three harnesses, and is used for dresses, négligées, babies' sacques, etc.

Imperial Ottoman. A heavy-ribbed, piece-dyed bengaline, with soft finish.

India Silk (Eng.); **Soie d'Inde** (Fr. pr. *swah d'and*). A name applied to the plain woven silk manufactured in India on the primitive hand looms. The warp and weft are woven evenly and produce a beautiful natural luster. It is similar to China and Japanese silk. In fact, most of these fabrics come from China and Japan, India silk being almost unknown in this country as so little of it is exported. The durability of these silks is about the same, and there is little difference in the prices.

Japanese Silk. A term applied to the plain woven silk manufactured in Japan. The warp and filling of this fabric are identical in size and color, and being woven evenly produce a beautiful natural luster. The weave is smooth and soft. It is dyed in plain colors. The figured goods are printed in much the same way as calico. It is used for waists, gowns, and fancy underwear. Habutae is the common Japanese silk.

Jersey Cloth. Silk jersey cloth is popular at present. It is a knitted silk fabric, not woven, and is generally dyed in plain colors. It is expensive, and is used for women's dresses, wraps, and silk gloves. It is elastic and durable and gives excellent service.

Kaiki (Jap.). A heavy all-silk Japanese fabric.

Ka-Ne-Ko Stripes. Striped warp filled with coarse, rough silk.

Kensington Silk. A printed tussah pongee.

Kikai (Jap.). A waste made in reeling raw silk.

Kiota. A piece-dyed, light-weight frisson; it has coarse, rough silk filling.

Lansdowne. A light weight twilled fabric with a silk warp and worsted filling, used for women's wear.

Levantine (Fr. and Eng.). A twilled weave, in which foulards are often woven.

Liberty Satin. Named after Liberty & Co., of Paris and London. A very soft, piece-dyed satin fabric, made on 8 or 12 shafts, with raw silk warp and single spun silk filling.

Louisine (Fr. and Eng.). A silk with a coarse, mealy surface, like a minute basket weave, made by weaving two or more warp threads together in a plain weave.

Lustreux. An all-silk pieced-dyed material with a faille face.

Lustrine (Fr.); **Lustring, Lutestring** (Eng.). A stout, glossy silk fabric.

Maline. (Fr. and Eng. pr. *Mahl-een*, from the city of Malines or Mechlin). A fine net fabric of silk, similar to tulle. Maline is used for veilings, dresses, hats, and scarfs. It is not durable, as its stiffness, from sizing, is destroyed by dampness.

Marceline (Fr. pr. *Mar-sel-een*, from the French town, Marcelin). A light, thin, closely woven diaphanous fabric of plain weave.

Matelassé. Matelassé silks have raised patterns and are usually of one color, with a rich flowered pattern showing only by its relief or embossed appearance.

Marquisette (Fr. and Eng.) A plain, open fabric, made with grenadine weave.

Messaline (Fr.). Named after Messalina, wife of the Roman emperor Claudius. A sheer, diaphanous, closely woven five-shaft satin, exquisitely soft and brilliant.

Milanaise Cords. (From Milan.) Fabrics with warp ribs made of cotton cords, or other bulky yarn, over which special silk warp threads are made to work with doups, so as just to cover the cotton cords.

Milleraies (Fr. pr. *meel-ray*, thousand stripes). A very narrow striped effect.

Mogue Pongee. A very rough Shantung pongee.

Mogul Pongee. A rough pongee.

Moire (Fr. pr. *mwar*). "Watered" or clouded silk, the effect being produced by heavy pressure, usually coupled with heat. Fabrics with pronounced ribs show the effect the best. It is used for dresses, ribbons, and linings, and is attractive and durable.

Moire Antique (Fr. pr. *mwar anteek*, ancient). Usually applied to rich qualities, and showing pronounced markings of an irregular character.

Moire à Pois (Fr. pr. *mwar ah pwah*, like peas). Having small round spots on a watered ground.

Moire à Rétour (Fr. pr. *mwar ah ray-toor*, reverse). A fabric specially woven for watering, figured on but one-half its width, which when folded and pressed imprints and so reproduces the figured pattern on the unfigured side, the two looking then exactly alike.

Moire Française (Fr. pr. *mwar frong-saize*, French). A striped moire, rollers of suitable width and spacing being used as required in pressing the pattern.

Moire Imperiale (Fr. pr. *mwar anpay-re-al*, imperial). An all-over watered effect, but without sharply defined lines.

Moire Metallique (Fr. pr. *mwar may-tahl-eek*, metallic). A moire having a metallic luster.

Moire Miroir (Fr. pr. *mwar meer-war*, mirror). Two rich corded fabrics are woven together, one above the other, being connected only by occasional threads. They are moired without folding, and when the two pieces are separated, a rich, soft, velvety, watered effect is the result.

Moire Nacrée (Fr. pr. *mwar nah-cray*, like mother-of-pearl). Applied to fabrics of such construction and color that an iridescent mother-of-pearl effect results. Goods for moire nacrée are not folded up the middle.

Moire Ocean (Fr. pr. *mwar o-say-an*, ocean). A moire giving undulating, wavelike effects.

Moire Poplin, Watered Poplin. These wool or cotton-filled fabrics give well-defined effects when watered, the wool filled goods giving a softer effect.

Moire Renaissance (Fr.). Moire having the effect of a Renaissance design.

Moire Scintillante (Fr. pr. *mwar san-tee-yong*, scintillating). A glittering, lustrous, watered effect.

Moire Soleil (Fr. pr. *mwar so-lay*, sun). A brilliant, shiny, indistinct moire; it comes up well on louisine fabrics.

Moire Suprême (Fr. pr. *mwar soo-prehm*, supreme). A watered satin of high quality.

Moire Velours (Fr. pr. *mwar vel-oor*, velvet). A moire having an all-over effect, with soft, velvety lines.

Moline. A heavy spun warp, tram filled taffeta.

Monk's Cloth. Basket weave made from rough tussah spun silk.

Mousseline de Soie (Fr. pr. *moo-sel-een de swah*, silk muslin from city of Mossoui, near the site of Nineveh). A chiffon with a firm finish.

Mozambique. Grenadines with large colored flower designs in relief.

Mummy Cloth. A fabric with a weave of a rough or granulated character, suggesting the appearance of the cloth in which the Egyptian mummies were wrapped.

Mysore Silk. Printed tussah pongee.

Natté (Fr. pr. *nah-tay*, matting, plait); **Basket Weave** (Eng.). Small basket weave patterns. These weaves must be properly bound, or the goods will "slip" — unless a small repeat.

Net (Eng.); **Filet Rets** (Fr. pr. *fee-lay ray*). Open mesh material used for veils, etc.

Non-spottable Pongee. A yarn-dyed, soft-finished pongee which does not spot readily with water.

Nun's Veiling. A fine, sheer worsted fabric used for veils, etc.; also made in silk. Usually black or plain weave in plain colors. It is used in dresses, babies' cloaks, children's dresses, kimonos, etc.

Obiji (Jap. from *obi*, a sash, and *ji*, fabric). A fabric made for use in making Japanese sashes.

Organdie (Fr. *or-gan-di*, book muslin); **Organdy** (Eng.). A light, transparent muslin of silk or cotton.

Organzine. A silk fabric, made with warp and filling of the same size. Organzine is the name given the twisted silk thread in Italy, where it is made.

Ottoman. A heavy, plain fabric with wide, flat ribs. The filling may be silk, worsted, or cotton.

Paillette de Soie (Fr. pr. *py-et de swah*, spangles of silk). A fabric so colored and woven as to show a spangled effect, or one to which spangles have been applied.

Palada Velvet. Yarn-dyed velvet.

Panne. This name is applied to a range of satin-faced velvet or silk fabrics which show a high luster produced by pressure. The word *panne* is the French for plush.

Parisienne (Fr.). A fabric of silk and wool.

Peau de Chamois. An all-silk armure with very soft finish.

Peau de Cygne (Fr. pr. *po de seen*, swan skin). A satin weave fabric of soft, lustrous finish.

Peau de Soie (Fr. pr. *po de swah*, skin of silk). A soft, satiny fabric, of good quality, with a dull luster and a somewhat grainy appearance, made in both single and double face. The fabric is woven with a pattern of fine, close ribs extending weftwise of the fabric. It is an eight-shaft satin with one point added to the original spots on the right or left, imparting to the fabric a somewhat grainy appearance. The best grades of peau de soie present the same appearance on both sides, being reversible. The lower grades are finished on one side only.

Pekin Stripe. A strong, contrasting striped fabric, the stripes being usually alternately of satin and grosgrain.

Plush (Eng.); **Peluche** (Fr. pr. *pel-oosh*). A pile fabric having a longer pile than velvet, being over 1/8 inch in length. Pile is made principally from silk, worsted, or mohair. Silk is used in the silk seal plush, imitating sealskin.

Plush, Hatter's. A silk plush of special construction for use in making men's high hats.

Pompeian Velvet. A yarn-dyed organzine velvet.

Pongee. (Said to be a corruption of Chinese *punchi*, signifying homemade or home woven. Another suggestion is that the word is a corruption of *pun-shih*, a native or wild silk.) A soft, unbleached, washable silk, woven from the cocoons of the wild silkworm, which feeds on the leaves of the scrub oak. Immense quantities in a raw state are annually shipped from China to this country and Europe, where they are bleached, dyed, and ornamented with various styles of designs. It is boiled off and dyed in the piece. The name is also applied to a variety of dress goods woven with a wild silk warp and a fine worsted weft.

Poplin (Eng.); **Popeline** (Fr. pr. *pope-leen*, a French name). The French fabric is said to have been first introduced during the early part of the sixteenth century at Avignon, then a papal diocese, and to have been so called in compliment to the reigning pope. A fabric constructed with a silk warp and a filling of wool heavier than the silk, which gives it a corded surface.

Poplin manufacture was introduced into Ireland in 1693 by a colony of fugitive French Huguenots. The industry concentrated at Dublin, where it has since remained. The Irish product is celebrated for its uniformly fine quality. It is always woven on hand looms, which accounts for the high price it commands in English and American markets. The wool used is a fine grade of Cape or Australian, which is the most suitable in texture and length of fiber. The silk is unweighted Chinese organzine. The result is a rich, handsome fabric, resembling whole silk goods in appearance, but inferior to them in durability, and produced at a much less cost. It is used for ladies' waists, wraps, and gowns.

Figured Poplin. A stout variety, ornamented in the loom with figures. The ground is composed of clear, sharp cords extending across the web. It is sometimes woven entirely of silk, but oftener of silk and wool. Used for high class upholstery purposes, and for curtains and hangings.

Terry Poplin. A silk and wool dress fabric in the construction of which the alternate warps are thrown upon the surface in the form of minute loops.

Poplinette (Fr.). An extremely light-weight poplin.

Poult de Soie (Fr. pr. *poolt de swah*). A rich, soft and thick satin fabric.

Punjab Silk. A very rough, heavy, lustrous, decorative silk.

Pussy-willow Silk. A soft, thin silk with a rather dull surface. This silk wears well and is quite attractive. It is used for dresses, linings, and waists.

Radium Silk. This fabric is soft, thin, and smooth. It is very light in weight, and wears well. Used for dresses, waists, petticoats, and underwear.

Radzimir, Rhadzimir. A broken twill effect made on 8 harnesses.

Ratine (Fr. pr. *rat-een*); **Rateen** (Eng.). A fabric having a coarse or knotty appearance, made in silk, and wool and cotton.

Reps Filling. Fabrics ribbed lengthwise, only the filling, which makes the ribs, being seen.

Reps Warps. (A corruption of ribs.) Fabrics ribbed crosswise, only the warp, which makes the ribs, being seen.

Revena Velvet. A yarn-dyed spun velvet.

Rhadamés (Fr. pr. *rad-am-ay*). A good quality fabric, with an indefinite twill, made on 12 shafts.

Roman Stripes. Brilliant contrasting cross stripes of silk filling, woven so as to make a reversible cloth, usually made on a cotton warp, none of the warp showing.

Royale (Fr. pr. *roy-ahl*, royal). A plain ribbed fabric, with the ribs broken at intervals; the same as barathea.

Rubaya. An all-silk cloth woven after the manner of the fine wool serges made in Roubaix, France.

Samite (Eng. pr. *sam-it*). In old English a stuff of silk, velvet, or satin.

Sarcenet, Sarsnet (from stuff made by the Saracens). A firm, thin, woven silk of the taffeta order, resembling veiling, now used as millinery lining. The name

comes from the Saracens, who wore it in their headdresses.

Satin (from Zaytown in China). A foundation or basic weave in which the filling is arranged to bind the warp as seldom as possible, and is so spaced that on the face of the fabric practically nothing shows but the warp, thus making an extremely smooth and lustrous face. When satin first appeared in trade in southern Europe, it was called *aceytuin*. The term slipped through early Italian lips into *zetain*, and coming westward the *i* was dropped, and the word smoothed itself into *satin*. There is evidence that the material was known as early as the fourteenth century in England, and probably in France and Spain previous to that time, though under other names.

In the weaving of most silk fabrics the warp and filling intersect each other every alternate time (as in plain weaving), or every third or fourth time (as in ordinary twill weaving), in regular order; but in weaving satin the fine silk warp appears only upon the surface, the filling being effectually covered up and hidden. Instead of making the warp pass under and over the filling every alternate time, or over two or three filling threads in regular order, it is made to pass over eight, ten, twelve, or more filling threads; then under one and over eight more, and so on. In passing over the filling, however, the warps do not interweave at regular intervals, which would produce a twill, but at irregular intervals, thus producing an even, close, smooth surface, and one capable of reflecting the light to the

best advantage. The filling of low-grade satin is generally cotton, while in the better goods it is silk. Common satin is what is technically known as an eight-leaf twill, the order in which the filling thread rises being once in eight times. Rich satins may consist of sixteen-leaf to twenty-leaf twills. The cheap qualities of cotton-back satin, particularly those that sell at wholesale for fifty cents and under, are not made to any extent in this country, our manufacturers being unable to compete with foreign mills in these lines.

Satins are woven with the face downward, because in weaving, say a sixteen-leaf satin, it would be necessary, were the surface upward, to keep fifteen heddles raised and one down, whereas with the face of the cloth under, only one heddle has to be raised at a time. When first taken from the loom, the face of satin is somewhat flossy and rough, and hence requires to be dressed. This operation consists of passing the pieces over heated metal cylinders which remove the minute fibrous ends and also increase the natural brilliance of the silk. Cotton-back satins are used by coffin manufacturers, fancy box makers, fan makers, and by the cutting-up trade. Rich satins are used in making ladies' gowns and waists.

Satin Athena. An all-silk satin, piece dyed.

Satin Charmeuse. Piece-dyed satin with a very hard-twisted organzine warp. It is usually made with spun silk filling. The distinguishing features of charmeuse are its soft feel and its dull luster.

Satin, Cotton-back. A lining satin of extensive use, made with raw silk warp and cotton filling, and dyed in the piece.

Satin Crêpe. A fabric with a rich satin warp and crêpe twist filling; it is difficult to dye perfectly.

Satin de Bruges (Fr. pr. *sah-tan de broozh*, satin of Bruges). A fabric of silk and wool with a satiny face, used chiefly for upholstery.

Satin de Chine (Fr. pr. *sah-tan de sheen*, satin of China). A soft, drapy satin, with crêpe-like finish.

Satin de Lyon (Fr. pr. *sah-tan de lee-on*, satin of Lyons). A skein-dyed, satiny cloth of firm construction, woven in a five-harness twill.

Satin, Double-face. A reversible satin, having a back warp as well as a face warp.

Satin Duchesse (Fr. pr. *sah-tan doo-shess*, duchess satin). A rich quality of all-silk satin, woven on 8 or 12 harnesses.

Satin Empress. Liberty satin.

Satin Façonné (Fr. pr. *sah-tan fah-son-nay*, wrought or figured satin). A fabric with a satin ground on which is a Jacquard figured pattern.

Satin Feutré (Fr. pr. *sah-tan feuhtray*, felted satin). A satin with the filling made of single spun yarn which is then teasled out so as to make a furry back. Usually piece dyed and woven on 8 shafts.

Satin Grec (Fr. pr. *sah-tan grek*, Greek satin). A 12-harness satin, with a specially close binding.

Satin Imperial. All-silk satin, printed.

Satin Luxor. A rich satin of subdued luster, usually made on 12 shafts. A double-faced peau de soie. The name is also applied to a wool-filled satin.

Satin Merveilleux (Fr. pr. *sah-tan mair-vay-yeu*, marvellous satin). A satin showing a light, lustrous twill. Made usually in contrasting colors of warp and filling.

Satin Messaline. A fine, soft, light-weight, all-silk satin, closely woven and finished with a brilliant luster on both sides.

Satin Panne. A heavy piece-dyed satin of pure dye, reeled silk.

Satin Serrano. A light, piece-dyed satin.

Satin Taffeta (Fr). A fabric with a satin weave on one side and a taffeta on the other.

Satin Turc (Fr.; Turkish satin). A satin weave on a fabric showing a fine herringbone cross-over effect.

Savona Velvet. A yarn-dyed Jasper velvet.

Serge (Eng. and Fr.; Latin, *seriea*, silk). A twilled fabric, originally silk, now usually made of worsted.

Serge Moirée (Fr. pr. *sergh mwa-ray*); **Moreen** (Eng.). A ribbed fabric, plain or striped, with spun silk warp and glazed cotton filling, moiré finish. Mercerized cotton is now largely used for the warp.

Shantung (Chinese, from the Chinese province of that name). Rough, plain fabrics made from tussah silk. Pongees are ecru in color.

Shikeginu (Jap). Habutae, woven with regular warp and doupion filling.

Shikii. Piece-dyed, heavy frissons; coarse, rough silk filling.

Shikii Brocade. Jacquard frissons, or filled with coarse, rough silk.

Shikii Broche. Jacquard frissons; coarse, rough silk filling.

Shoetop Silk. Heavy twilled or satin fabrics, usually figured, or with cotton filling, are made for this purpose.

Shower-proof Foulard. Satin-faced twill.

Shusu Habutae (Jap.). Habutae woven in a satin weave.

Sicilienne (Fr.). **Sicilian.** A corded, silk warp, worsted filled fabric. Also a light chiffon-like fabric.

Soleil. Satin-faced cloth, woven with a fine line, a stripe running lengthwise of the piece. It is usually made in solid colors and piece dyed. *Soleil* is French for sun, and applies to the brightness of the finished cloth.

Stratford Velvet. Piece-dyed Jasper velvet.

Surah (from Surat in India). A twilled silk, generally woven two-and-two.

Tabbinet. Originally a delicate kind of tabby (*Stormouth*). A figured texture of silk and worsted, having much the appearance of a poplin. (*Century:* A fabric of silk and wool, like a poplin, with a watered surface, chiefly used for upholstery.)

Tabbis (Fr. pr. *tah-be*, from Atabi, a quarter of Bagdad, — named after Prince Atab — where first made): **Tabby** (Eng.). A kind of rich silk with a wavy or watered effect. An old name for silk watered or figured. The name "tabby" is much used to denote a plain weave.

Taffeta, bright. A plain or solid colored taffeta.

Taffetalene. A spun, filled, piece-dyed pongee with a rusting finish in imitation of taffeta.

Taffetaline. A plain weave, piece-dyed fabric, with organzine warp and spun silk filling.

Taffetas (Fr. pr. *taf-fe-tah*); **Taffeta** (Eng.; also "taffety" from Persian *taffaj*, twisted, woven). A skein-dyed dress silk of plain weave, with a fine cross-ribbed appearance. Ranges from 70 to 120 picks per inch, averaging 90 to 100.

Taffeta is one of the oldest weaves known, silk under this name having been in constant use since the fourteenth century. During this long period the term has been applied at different times to different materials. It is a thin, glossy silk of plain texture or woven in lines so fine as to appear plain woven. The weave is capable of many effects in the way of shot and changeable arrangements, which are produced by threads of different colors rather than by any special disposition of warp and filling. Taffeta has the same appearance on both sides. It is piece dyed in numberless plain colors, and also produced in a great variety of ornamental patterns, such as fancy plaids, cords, and stripes (both printed and woven). The following considerations contribute chiefly to the perfection of taffetas, viz.: the silk, the water, and the fire. The silk must not only be of the finest kind, but it must be worked a long time before it is used; the watering, which is given lightly by any acidulous fluid, is intended to produce the fine luster; and lastly, the fire and pressure, which have a

particular manner of application. Its wearing qualities are not of the best. The cloth cracks or breaks, especially if plaited. It is used for gowns, shirt-waists, linings, petticoats, etc.

Taffetas Caméléon (Fr. pr. *taf-fe-tah cah-may-lay-own*); **Taffeta Chameleon** (Eng.). A multi-colored taffeta, usually made with colors in the filling, contrasting with a third color in the warp, producing an iridescent, changeable effect.

Taffetas Chiffon (Fr. pr. *taf-fe-tah she-fong*, rag-like or soft taffeta). A good quality of taffeta, finished with much heat and pressure till very soft and lustrous.

Taffetas Façonné (Fr. pr. *taf-fe-tah fah-son-ay*, wrought or figured taffeta). A taffeta with a Jacquard figured design.

Taffetas Glacé (Fr. pr. *taf-fe-tah glah-say*, frosted taffeta). A taffeta with contrasting colors in warp and filling, making a "shot" effect.

Taffetas Lustré (Fr. pr. *taf-fe-tah loo-stray*); **Lustered Taffeta, Lustring, lutestring**. A stout, brilliant fabric.

Taffetas Uni (Fr. pr. *taf-fe-tah oo-nee*, from *uni*, plain, smooth, etc.). Plain taffeta.

Tatsu Broché. Jacquard broché filled with doppion, or double cocoon silk.

Terry Cloth. Fabrics with the face, or face and back, made with loops like a Turkish toweling.

Tie Silks. A name given to a large variety of plain and fancy goods, used for making men's cravats. Silk from which cravats are made.

Tonquin Broché. Jacquard broché of coarse, rough silk.

Tricolette. A fairly fine knitted fabric usually made of artificial silk. It comes in tubular form. It is generally in plain colors, but sometimes it is found with printed stripes. Used for dresses, sweaters, scarfs, suits, and petticoats.

Tricot (Fr. pr. *tree-co*, stocking net). A weave showing a very narrow, inconspicuous stripe, like a knitted effect. Usually made in wool, but sometimes in silk.

Tulle (Fr. and Eng., pr. *tool*, from the town Tulle in France). A delicate kind of net, with a small mesh, made on a pillow, as lace, by young women of Tulle, France.

Tussah, Tussur, Tussore (from the tussah silkworm). Brown colored silks produced by the various kinds of wild silkworms, and fabrics made from such silks.

Twill. A weave showing a diagonal effect. Twills are made in numberless varieties. The twill is one of the three basic weaves.

Tyrian Taffeta. An organzine pure taffeta.

Umbrella Silk. Twilled or plain silks, with special selvedges and specially dyed, used for covering umbrellas.

Uni (Fr. pr. *oo-nee*, plain, smooth, even). Applied as a description of plain weave.

Usuginu (Jap.). A kind of thin habutae.

Velour (French for velvet). A trade term of somewhat loose application, being used indiscriminately to describe a great variety of textures so constructed or finished as to present a velvet-like surface. It is usually a velvety fabric made of coarse, stiff pile, after the

manner of plush; while at present it is also made of jute, cotton, and worsted, it was originally constructed of linen. It is produced in numberless forms, both plain and in fancy effects.

Velour de Luxe. A pure-dyed spun-silk velour.

Velours Chiffon (Fr. pr. *vel-oor she-fong*, chiffon, or rag-like velvet); **Chiffon Velvet** (Eng.). A very light, soft and pliable velvet.

Velours Gaufré (Fr. pr. *vel-oor gof-ray*); **Embossed or Stamped Velvet** (Eng.). A figured velvet with the pattern in relief. The effect may be obtained in the weaving, or by printing with embossed rollers.

Velours Envers Satin (Fr. pr. *vel-oor ong-vair sah-tan*, reverse satin velvet). A fabric with velvet face and satin back. Ribbons are sometimes made in this way.

Velours Épingle (Fr. pr. *vel-oor ay-pan-gle*, faced velvet); **Panne Velvet** (Eng.). A velvet finished with a hot pressing or ironing effect, giving a peculiar luster.

Velours Paon (Fr. pr. *vel-oor pah-on*, peacock velvet). A special heavy-pressed finish given to velvets is called "paon."

Velours Renaissance. Pure dyed and printed spun velour.

Velours Russe (Fr. pr. *vel-oor roos*). Russian velvet.

Velvet (Eng.); **Velours** (Fr. pr. *vel-oor*). A fabric with a short, soft, thick pile face, and plain back. It may be all silk, silk face, or all cotton. Fine velvet is made wholly of silk. Much spun silk is used in velvets. If the pile is deeper than one-eighth inch the fabric is called plush.

Velvet, Chenille (Fr. caterpillar). A fabric with a chenille filling, giving a double-faced velvet effect.

Velvet, Chiffon. Chiffon velvets are very light, soft, and pliable.

Velvet, Cut. A velvet with face filling effect, cut by a knife to produce the pile, or with rows of loops similarly cut. The velvet figures on certain goods are made in this way.

Velvet, Mirror. A velvet with the pile ironed down.

Velvet, Uncut. A velvet with a looped pile, or face filling, uncut.

Velvet, Wire. A velvet which, in weaving, has a series of wires inserted under the pile warp, and which, when withdrawn, make a face with regular rows of loops across it, which may be then cut to form a pile.

Velveteen, Cotton Velvet. A velvet with both cotton pile and cotton back. Usually woven with a plain back, not twilled as silk velvet.

Tabby Velvet. The lowest grade of cotton velvet, used for covering cheap coffin cases and lining, sold by the inch in widths which range from sixteen to thirty-two inches. Originally made in Bagdad for wall covering, its name being derived from a section of that city.

Voile (Fr. pr. *vwal*); **Veiling** (Eng.). An open mesh, plain weave, piece-dyed fabric, of light weight, and made with well-twisted yarn. The name comes from the French **voile**, meaning a veil, a light fabric usually more or less transparent, intended to conceal the features in whole or in part, or to serve as a screen against sunlight, dust, insects, etc., or to emphasize or preserve

the beauty. The custom of wearing veils had its origin in the early ages in the desire of semisavage man to hide the face of the woman of his choice, and is a survival of the ancient custom of hiding women that is found even at the present day in Eastern countries. Voile is a transparent, wiry material with a square mesh.

QUESTIONS

1. What is the difference between georgette and crêpe de Chine in weave?
2. How would you distinguish in structure between crêpe meteor and Canton crêpe?
3. What is the difference between messaline and taffeta?
4. What is the difference between faille and poplin?
5. Distinguish between a warp print and a cloth print.
6. Distinguish between baronet satin and straight satin.
7. What is the difference between silk chiffon and voile?
8. What is the difference between Shantung and pongee?
9. What is the difference between charmeuse and satin?
10. How is habutae made?
11. Describe from the name the characteristics of chiffon taffeta.

CHAPTER XVIII

LINEN

Examine the material used for high grade tablecloths, towelings, lace, etc. This fabric, so different from cotton, is called *linen*. Linen is used where strength, luster, absorbing power, and wearing qualities are desired. For instance, it is employed in toweling for its absorbing power; in decorative coverings (tablecloths and centerpieces) for luster as well as for body and stiffness. Linen is more expensive than cotton because a great deal of care is required in producing the fiber from the stalk and in bleaching the fabric. In order to understand the value of linen, it is necessary to know its physical and chemical properties and how it differs from cotton.

Flax. Flax or linen occupies the first position in the group of stem fibers,[1] being not only the oldest, but, next to cotton, the most important vegetable spinning material known. Its value is increased by the fact that the flax plant readily adapts itself to various conditions of soil and climate, and in consequence has

[1] The stem fibers such as flax, jute, ramie are called *bast* fibers, and before any of them can be utilized industrially, steps have to be taken to render them free from gum. When the stems of these plants are severed, the juice tends to oxidize through contact with the air and forms a gum of a peculiarly tenacious character.

gained access to northerly districts and cool highlands. Although flax has lost some of its importance by reason of the successful competition of cotton, nevertheless it still forms one of the chief articles of an industry which merits all the care bestowed upon its cultivation and proves highly profitable.

The Physical Structure of Flax. Flax, when seen under the microscope, looks like a long, cylindrical tube of uniform thickness, with lamina so small as to be visible only as straight black lines lengthwise of the fiber, and frequently exhibits small transverse cracks. It is never twisted like cotton fiber. Its color varies from pale yellow to steel gray or greenish tints. The difference in color is due chiefly to the process of "retting." Its average length is about twenty inches, and its tensile strength is superior to that of cotton. It will absorb moisture, 12 per cent being the standard allowance made.

Flax is used for making linen thread and cloth, yarn, twist, string fabric, and lace. In its composition it is almost purely an unlignified cellulose, and its specific gravity is 1.5.

Flax is a better conductor of heat than cotton, hence linen goods always feel colder than cotton goods.

History of Linen. Linen has always been held in great esteem. The garments of the Egyptian, Hebrew, Greek, and Roman priests were made of the finest linen. During the Middle Ages, Italy, Spain, and France were celebrated for their linen fabrics. Religious intolerance in France drove 300,000 of her best textile workers into

England, Ireland, and Scotland. Irish linen weaving began as early as the eleventh century.

Linen has never been largely woven in America except in the coarser forms of crash and toweling, although linen weaving was one of the colonial domestic industries. The reason America has not been able to equal Europe in its production of fine linens is because the process for separating the fiber from the stalk requires the cheapest form of labor to make it profitable, hence most of the American grown flax is raised only for seed.

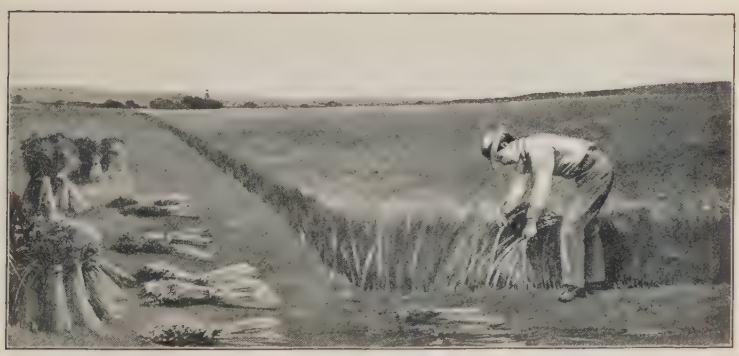
Flax is grown extensively in nearly every country in Europe. Referring to the period previous to the World War, Russia produced about four-fifths of the world supply. Other countries producing important quantities were Austria-Hungary, Italy, Germany, Roumania, France, Belgium, Ireland, and Holland, in the order named. The various countries and many of their districts produce fibers characteristically different, the variation being due to soil, climate, and method of manipulation, the results being dissimilar in color, appearance, strength, and general quality.

Flax may be raised for two purposes: (1) Primarily the seed, for linseed oil; and (2) the fiber, for linen. If the plant is to be raised for seed, it is allowed to "overripen" which makes the fiber of poor quality. On the other hand, if the plant is raised for fiber only, the plant is used while it is green and before the seeds develop.

The plant is an annual, of delicate structure, and is gathered just before it is ripe, the proper time being in-

dicated by the changing of the color from green to brown. At the time of gathering the whole plant is uprooted, dried on the ground, and finally rippled with iron combs, to separate the stalks from the leaves, lateral shoots, and seeds.

The best fiber amounts to about 75 per cent of the stalk. To separate this valuable commercial product from the woody matter, the stalks are first subjected



PULLING FLAX IN MINNESOTA

to a process termed *retting*, which is steeping them in water until they are quite soft. Then follow the mechanical processes to further the production of the fiber and free it from all useless matter.

These are as follows:

1. *Crushing or Beating.* This consists of breaking the woody matter with the aid of mallets or stamping mills.

2. *Breaking.* This is passing the stalks through a series of horizontal rollers to break further the woody matter and at the same time separate the greater part of it from the fiber.

3. *Scutching.* The object of this process is to remove completely the woody matter, and it is done by means of rapidly revolving wooden arms or blades, which beat the firmly held flax until it is sufficiently cleaned and separated. Less than five per cent of the ordinarily green flax as pulled is available as scutched flax. One can readily understand that it would be impossible for American manufacturers to compete with foreign manufacturers in scutching flax, since peasant labor is very cheap.

4. *Hackling.* The scutched flax is sent to American mills ready for hackling, which consists in drawing the scutched flax through iron combs which still further open the fiber. Fineness of fiber depends upon the number of times it is hackled, each time with a finer instrument, which secures the different degrees of subdivision. Then the fibers are sorted and classified as to length and quality and laid in parallel forms ready for spinning and manufacture into linen.

After hackling and sorting, the flax is tied up in bunches of about 25 pounds and put into stock. It is usually stored in a damp place, where it improves with age.

The next operation is to allow the small pieces of flax to run through rollers. The instant the fibers come between these rollers they are drawn out and thus form a *sliver* or continuous strand of fibers. This sliver then passes through roving machines, where it is given a soft twist. It is now ready for spinning.

Spinning is performed by either of two distinct

methods, wet or dry. Dry spinning is not practical for fine yarns and is used only for the coarse sizes. Wet spinning is used in the production of all fine yarns, and of coarse yarns for certain purposes.

The operation of wet spinning is the same in principle as dry, but it is performed by a somewhat different method. At the top of the wet spinning frame there is a trough of hot water. The roving first passes through this trough, which softens the gum and allows drafting with a shorter reach. The short reach makes a more level and smooth appearing yarn, and the finer sizes can be produced in no other way.

Following this operation comes the reeling, which is a simple process and consists of transferring the yarn from the bobbins to hanks. The yarn in this case is reeled on a revolving collapsible drum, and the hanks are here made a certain standard weight.

Bleaching. Linen is bleached in the form of yarn, thread, and cloth. This is a difficult and long process owing to the large amount of natural impurities present in flax fiber, and the difficulty of removing or dissolving them. Although the formula for bleaching linen is very similar to that for cotton, it takes a great deal longer to bleach linen, and a number of cycles — quarter bleach, half bleach, three quarter bleach, and full bleach — are employed. The fabrics are usually sold by designation quarter bleach, half bleach, three quarter bleach and full bleach. Bleaching is now done as a rule by chemical processes, and when chemicals are used great care must be taken as to their strength and

the length of time the cloth is allowed to remain in them. In olden times sour buttermilk was rubbed into the linen, and then bleaching was finished out of doors by sun and rain. " Unbleached " linen is treated in the same way as bleached, only the process is not carried to such an extent. In Ireland, famous for its bleaching, chemicals are used in the earlier stages of this process,

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STACKS OF FLAX IN BELGIUM

and then fine linens are spread out on the grass to improve their color, and to purge them completely of any chemicals used. This process, called grass bleaching, makes the fabric softer and whiter and gives it better wearing qualities. After bleaching, linen is washed, dried, starched, and put through heavy machines to give it a glossy finish.

Characteristics of Good Linen. Linen is noted for its smoothness of texture, its brilliancy — which launder-

ing increases, — its wearing qualities, and its exquisite freshness. The celebrated Irish linen is the most valuable staple in the market, and on account of its fineness and strength, and particularly its bright color, it attains an unapproachable excellence because the best processes are used throughout the entire manufacture.

Linen is less elastic and pliable than cotton and bleaches and dyes readily. Flax from all countries is woven into table linen, though very fine linen must have carefully prepared fiber. Linen should be soft, yielding, and elastic, with almost a leathery feel. Fineness of linen does not always determine good wearing qualities.

French and Belgian linens, while fine in thread and attractive in design, are not as serviceable as Irish linens. Germany makes a good wearing linen, but not a large variety of patterns. They are often printed and dyed. Scotch linens are now used more than other kinds. Scotch linens are lighter than Irish, and have a silver white finish and stylish designs. The Belgium linens have more sizing than the Irish, although they are very attractive.

Sources of Flax

Holland	Ireland
Belgium	Canada
Germany	U.S. (for seed only)

Sources of Manufactured Linens

Scotland	Belgium
Ireland	France
Germany	United States
Austria	

MANUFACTURED LINENS

Damasks and Napkins	*Towels*
Scotland	Germany
Ireland	Scotland
Germany	Ireland
Belgium	Austria
	U.S. (union)
Towelings	*Linen Sheetings*
Scotland	Ireland
Ireland	Belgium
Germany	France
United States	Scotland
Glass Checks	*Blouse or Dress Linens*
Ireland	Ireland
	Scotland
Canvas	*Bleached Waist Linens*
Scotland	Ireland
Ireland	France
	Belgium
Handkerchief Lawns, Cambrics, and Laces	*Fancy Linens, Doilies, etc.*
Ireland	Germany
Germany	France
France	Japan
	Madeira Islands
	Island of Teneriffe

Dyeing. Linen is more difficult to dye than cotton. This is due to the fact that while it has the same chemical composition as cotton — cellulose — it differs materially in its physical condition. The fiber of cotton is usually less than two inches in length, while that of flax is two or three feet in length. The cotton fiber consists of one elongated tube, while the linen fiber is made up of a multitude of fine filaments which prevent

the dyestuff from penetrating to the same degree as in cotton, therefore precautions necessary to overcome this difficulty have to be devised in order to obtain good solid shades in either dying or printing. Strong alkalies, such as caustic used in bleaching, have a slightly detrimental effect on the fiber cells. This change prevents the use of vat colors to the same extent as on cotton goods. The colors usually employed on linen are the direct colors, basic colors, mordant colors, and sulphur dyes. The direct colors are used solely for the dyeing of the linen fabric, and are applied in somewhat the same manner as in the case of cotton.

Finishing Linen. Linen is inclined to be stiff and uneven after it has been bleached. Therefore it is necessary to make it soft and give it luster. The first treatment, called *beetling*, consists in passing the linen in a damp condition through a machine made up of rollers and hammers. The cloth is beaten by the hammers until it is soft and the threads have assumed a uniform thickness. Then the cloth is passed through steam rollers — ironed very smoothly (called calendering) — to give it luster. The cloth is then folded, washed, pressed, and packed.

While linen is expensive, it wears well and has an air of refinement. Its luster is nearly as beautiful as that of silk, and this characteristic is of great advantage in tablecloths. The fiber can be spun to a very fine thread, which is used in making beautiful laces. It is strong, smooth, and soft, which are qualities very desirable in bed linen.

The surface of linen is not as porous as cotton, therefore it does not catch the dirt as easily. It requires less laundering than cotton. In addition, it has wonderful absorbing power, which makes it excellent for handkerchiefs and towels. It also allows the moisture to evaporate quickly, which is an added advantage in toweling.

One of the principal uses of linen is for the table, for coverings, damask, and napkins. The luster and whiteness of table linen make it very attractive.

Due to the high price of linen there is a tendency to offer substitutes in the market. As a result the use of linen has decreased during the last ten years. Its principal substitute is cotton. This replaces linen in the warp or filling, and the fabric so made is called union linen.

Pure cotton may often be made to look like linen by mercerizing, pressing, and by using compounds. The deception is so perfect that it defies the average person's eye and can be detected only after washing, when the short fibers of the cotton, showing on the surface, give a fuzzy appearance.

CHAPTER XIX

LINEN FABRICS

In weaving fine linens it is absolutely necessary to boil the yarns before weaving so as to make the cloth firmer and tighter. Then the yarn is warped and sized in exactly the same way as cotton.

The three fundamental weaves are used in making linens: plain weave for dresses, sheetings, etc.; twill weave for drilling; satin weave for table linen.

Great care must be exercised in weaving linen, as the fiber is not so elastic as cotton and will break at any additional strain.

There are many different kinds of linen fabrics on the market; each is adapted to a particular use and is made to meet the special requirements of that use.

Art Linen. A fabric used for embroidery, scarfs, doilies, etc. It has a round, even thread, woven in a plain weave so that the warp can be drawn easily.

Bird's-eye Linen. This fabric is used for toweling and has a woven design of a diamond with a dot in the center, hence the name bird's-eye diaper. It is used for babies' towels and consequently must be soft, lustrous, and absorbent, so as not to produce friction in contact with the skin. By frequent washing it loses the excessive absorbing power that a rougher surface might have. The cheaper grades are made of cotton.

Butcher's Linen. As the name implies, this is used for aprons by butchers. This use calls for a cheap but substantial linen from which stains can be easily removed, and which frequent and vigorous washing will not injure. After it has been laundered it should have a high luster. Cotton substitutes are frequently used, and these may be better than a poor linen.

Crash. A cheap, coarse, unbleached fabric used for towels. It was originally woven on hand looms by Russian peasants. The yarn is coarse and uneven, which causes the weave to be irregular.

Damasks come in two grades, single and double. The single damask has fewer threads, and the design is prominent only on the face. The double is reversible, that is, the design shows to advantage on both sides, because of the increased number of filling threads. This cloth is sold by the yard and sometimes by the pattern.

Huckaback. A strong fabric used for toweling. It must have good absorbing power and be rough in order to produce friction on vigorous application. The yarns must be even and have little twist so as to increase the absorbing power. Small squares stand out from the background.

Linen Crash. A durable fabric used for towels, dresses, etc. Since it has to be strong for the purpose, it is made of plain weave, irregular threads, and a high linen luster in the grey. It fades with frequent washing, due to bleaching, and naturally wrinkles because of the stiffness of the grey flax.

Handkerchief Linen. This is used for handkerchiefs, collars, waists, etc., and naturally must be of fine texture. It may be light or heavy, according to the thickness and fineness of the yarn. It has great absorbing power, wrinkles somewhat, but washes well and appears crisp.

Ramie. Ramie is a term used for linen suiting composed of coarse yarn. Ramie itself is very similar to linen, but it is difficult to manufacture and is not used extensively. It may be spun and woven into very fine linen handkerchiefs.

Characteristics of Linen Expressed as Selling Points. Summarizing the qualities of linen, we find that:

1. It is expensive, due to the labor and care necessary in producing the fiber.
2. It has a beautiful luster, due to smoothness of the fiber, which reflects the light.
3. It does not take on dirt as cotton does, because the fibers are not so porous.
4. It requires frequent washing and rinsing, because the fibers are stiff and not elastic, hence it creases easily.
5. It is useful for toweling and handkerchiefs, because it absorbs water and dries quickly.
6. It is usually more valuable in the white, due to lack of fastness of colors.
7. It does not lint or become fuzzy with frequent washing, due to the longer fibers, as compared to cotton, which has a tendency to lint because of its shorter fibers.

8. It keeps its shape if of high construction.

9. Cheap linens are not serviceable and will not last any longer, and in some cases not so long as mercerized cotton, because they are made of tow fibers, loosely twisted and woven and heavily sized. After the cloth is washed the sizing comes out, leaving the fabric soft.

QUESTIONS

1. State the differences between linen and cotton.
2. (*a*) Why is linen superior to cotton?
   (*b*) Is it cheaper or more expensive?
3. State the characteristics and the physical qualities of linen.
4. (*a*) Is linen a stem or seed fiber?
   (*b*) What is the color of linen in the raw (flax)?
5. What makes linen feel colder to the touch than cotton?
6. State some of the uses of linen.
7. Describe briefly the linen industry.
8. Describe the growth of flax.
9. What are the steps in producing linen from the raw state?
10. State two purposes in the raising of flax.
11. State some of the reasons why linen is not grown in this country.
12. Describe the method of producing fine flax.
13. What are the two methods of spinning?
14. Describe the process of bleaching. Why is linen more difficult to bleach than cotton?
15. Why is linen sold in three classes of bleach?
16. What are the characteristics of a good linen?
17. State in order the qualities of French, Belgian, German, Irish and Scotch linens.
18. Name the countries from which the following are obtained: linen, sheetings; linen doilies; fancy linens; laces; towelings.
19. Explain why few linens are dyed.
20. (*a*) What are the steps in finishing linen?
    (*b*) What gives the high reflective power to linen?

21. What are the substitutes for linen?
22. Describe the weaknesses of the substitutes.
23. Does linen become soiled as easily as cotton? Reasons?
24. Describe the following classes of linen: art crash; handkerchief; linen crash; double damask.
25. Give the selling points of linen.

CHAPTER XX

MISCELLANEOUS FIBERS

Hemp is a fiber that is obtained from the hemp plant. It grows principally in Russia, Poland, France, Italy,

LOADING HEMP IN MANILA

Asia, India, the Philippines, Japan, and some parts of the United States — Kentucky, Missouri, Tennessee, Ohio, Indiana, and New York. The original country of the hemp plant was doubtless Asia, probably that

part near the Caspian Sea. The preparatory treatment is similar to that for the flax plant, except that most of the work is done by machinery. Considered chemically, in addition to cellulose, hemp fiber contains a considerable amount of woody matter, differing in this respect from cotton. Its properties are color (pearl gray, with green or yellow tints), fineness (which depends upon the quality of the hemp; it is usually bought as fine as flax), and tensile strength (which is considerable and greater than that of flax). Its best qualities are its slight luster and its ability to resist to a great extent the tendency to rot under water. Owing to the fact that it is difficult to bleach, it is used chiefly in making string, cord, ropes, etc.

Sisal Hemp. Sisal hemp is a variety that grows extensively in Central America and the West Indies. The plant, the *agava rigida*, is similar to what is known in this country as the century plant. The fiber is found in the leaves which closely surround the stalks. The common hemp on the other hand is found closely surrounding the woody part of the stem. The fiber of Sisal hemp is obtained by scraping away the fleshy part of the leaves with large wooden knives or by machines.

Manila Hemp. Manila hemp is obtained in the Philippines. The plant belongs to the banana family and grows as large as a small tree. The hemp is obtained from the leaf stalks which appear to form the trunk of the tree. The fiber is larger, not so stiff, but

stronger than Sisal hemp. The fiber of Russian hemp is the strongest; that of Italian hemp the finest.

Jute. Jute is the name given to the fibers found in certain plants which grow principally in India, and the East Indian Islands. The common jute comes principally from the province of Bengal, India, where it was first known to science in 1725. The term jute was

FIELD OF SISAL HEMP

first applied to the fiber by Dr. Rosburgh in 1795. The plant is cut just about the time when it appears in full flower. The stalks are then bundled and retted by steeping in pools of stagnant water.

Jute occupies third position in importance of vegetable fibers in the manufacturing scale, being inferior to cotton and flax. Hemp is stronger than jute. Jute becomes weak when exposed to dampness.

It is extensively used for mixing with silk, cotton, flax, hemp, and woolen fabrics. The coarse varieties

are made into coarse fabrics - sacks, packing cloth, etc., while the finer varieties, in which the undesirable quality of growing darker with age is less apparent, are used for making carpets, curtains, and heavy plushes, for which they are very suitable.

Uses of Jute. Were it not for its fineness, silkiness, and adaptability for spinning, with the easy cultivation of the plant, jute would not to-day hold the position it has secured in the industrial world, for, compared with the other textile fibers, it is very inferior. Several American plants that are classed as weeds produce better and stronger fiber, but their cultivation and preparation are yet matters of experiment. One defect of jute is the difficulty in spinning it into the higher numbers of yarn. Its lack of durability is also against it, as the fiber cannot stand dampness, and even under the most favorable conditions rapidly deteriorates. The bleached fiber also loses its whiteness and in time oxidizes until it presents a dingy, yellowish brown color. Its strength is inferior to most other fibers, though it is amply strong for the coarse uses to which it is commonly put, such as the manufacture of gunny and burlap, where durability is of less consequence than primary cheapness.

The fiber is used in three forms of manufacture: Weaving into fine and coarse textures, in the making of fine twines and cordage, and in paper manufacture, the latter chiefly from jute butts and rejections.

Kapok; Silk Cotton. On account of the high price of silk, various attempts have been made to find satisfactory substitutes for it. There are certain seed cover-

ings of plants that contain very fine hair-like fibers with a luster almost equal to silk, but the staples are short and the texture weak. The kapok plant furnishes most of the commercial silk cotton on the market. The fibers of kapok are thin and transparent. They are extremely light, and the length is less than half an inch. Silk cotton has a smooth surface and therefore cannot be spun like true cotton, which has corded edges.

Ramie. Ramie, or China grass, is a soft, silky, and extremely strong fiber. It grows in southwestern Asia, is cultivated commercially in China, Formosa, and Japan, and is a fiber of increasing importance. Ramie is a member of the nettle family and attains a height of from four to eight feet. After the stalks are cleaned of a gummy substance, insoluble in water, it is known as China grass, and is used in China for summer clothing. In Europe and America, by the use of modern machinery and chemical processes, the fiber is cleaned effectively and cheaply. After it is bleached and combed, it makes a fine silky fiber, one half the weight of linen, and three times stronger than hemp. It is used in Europe to make fabrics that resemble silk, and is also used in making underwear and velvets. With other fabrics it is employed as a filling for woolen warps. It will probably be used widely in the United States as soon as cheaper methods of cleaning are devised.

Pineapple Fiber. The long, white, silky fiber yielded by the leaves of the pineapple plant, when spun, is used as a substitute for silk and flax and as a material for mixing with wool or cotton. The fiber is generally

considered to be one of the finest, longest, and strongest to be found in the entire vegetable kingdom. Samples cleaned, without scouring or bleaching, in the government experiments in Florida, in 1892, when twisted to the size of binding twine, showed a breakage strain of 150 pounds. As to the characteristics that render it readily adaptable for textile purposes, investigation has shown that the mere process of bleaching suffices to destroy the adhesion between the bundles of fibers as extracted from the leaf, and hence renders it fit for spinning in the same way as flax. The individual filaments are very fine, of regular size, and of remarkable flexibility, curling and crisping readily under machinery. These qualities render it specially applicable for sewing thread, twist, trimmings, laces, curtains, and the like.

In Europe, where it is used in the manufacture of various kinds of novelty fabrics and for mixing with cotton, linen, and silk, well cleaned pineapple fiber of average fineness is valued at 75 cents per pound. In China the fiber is manufactured into a strong fabric resembling coarse grass cloth, the chief use of which is for the inner garments of the agricultural class. This fabric is called *huang-li-pu*. In southern Mexico the Sapotic Indians weave it with wild silk into cloth of many colors, which they use for their finest clothing. In central Mexico the fiber is utilized for ropes, twine, thread, mats, bagging, and hammocks. From the wild pineapples of the Philippines the famous *piña* cloth is manufactured, highly esteemed for its delicate texture and durability. The value of the fiber for textile pur-

poses has long been known. In 1891, the fiber expert for the United States Department of Agriculture began a series of investigations into the practicability of utilizing the Florida leaves for fiber after the fruit has been gathered, as their utilization would give to the country a new industry. In the experiments made it was shown that the yield of fiber ranges from 45 to 60 pounds per ton of leaves. The average yield of good leaves was about 10 to the plant, each weighing nearly one pound. In the production of fiber on a commercial scale, the machine question was found to be an important matter. The machine used in the Department experiments for extracting the fiber was not adapted to treating large quantities of leaves, and was not automatic in principle. So far, no mechanical device which meets with general approval has been constructed for this purpose. In the Philippine Islands and China, where the leaves reach a length of from 5 to 6 feet, the natives extract the fiber by hand. The cost of labor necessary in extracting the fiber prevents its extensive use in the United States.

Tinsel. This term has long been used to denote a glittering metallic substance, as burnished brass, copper, or tin, made in sheets approaching the thinness of foil, and used in strips of threads for any purpose in which a sparkling effect is desired without much cost. Tinsel thread rolled from brass foil, or so-called Dutch metal, is produced in a great number of ornamental styles, both flat and round, and in all colors and shades, though usually in imitation of gold or silver. The bulk of

such materials used in this country is imported from Germany under the name of *lahn*. For manufacturing purposes it usually comes put up on spools about two inches long and containing from 25 to 50 yards. Tinsel is largely used in the production of novelty dress trimmings, braids, and cords, and for making various kinds of thread used in artistic needlework.

Tinsel threads are judged by the number of yards that come in one kilogram (2 1/5 lbs.) and by the quality of the plating used on the wire which is wound around the cotton. These goods come from 2000 meters to a Kilo to as fine as 50,000 meters to a Kilo and of course the finer the size the harder and slower is the process of manufacturing and the greater the value. The cotton threads run through a spindle and the flattened wire (*lahn*) is twisted around it on the outside. The machine is geared for a certain speed and the finer the size the slower the speed, as the very fine sizes cannot stand much pressure.

Metallic Threads. Metallic threads have always been used for decorating, particularly in rich fabrics. Fine golden threads, as well as silver gilt threads, and silver threads and copper wire, were used in many of the so-called Cyprian gold thread fabrics, so renowned for their beauty and permanence in the Middle Ages. These threads are now produced by covering flax or hemp threads with a gilt of fine texture.

Slag Wool. Slag wool is obtained by allowing molten slag (generally from iron) to run into a pan fitted with a steam injector which blows the slag into fibers. The fibers are cooled by running them through water, and the finished product is used as packing material.

Asbestos. Asbestos is a silicate of magnesium and lime, containing in addition iron and aluminum. It is found in Savoy, the Pyrenees, Northern Italy, Canada, and some parts of the United States. Asbestos usually occurs in white or greenish glassy fibers, sometimes combined in a compact mass, and sometimes easily separable, elastic, and flexible. Canadian asbestos is almost pure white, and has long fibers. Asbestos can be spun into fine thread and woven into rope or yarn, but as it is difficult to spin these fibers alone, they are generally mixed with a little cotton, which is afterwards disposed of by heating the finished fabric to incandescence. Because of its incombustible nature, asbestos is used where high temperatures are necessary, as in the packing of steam joints, steam cylinders, hot parts of machines, and for fire curtains in theaters, hotels, etc. It is difficult to dye.

Spun Glass. When a glass rod is heated in a flame until perfectly soft, it can be drawn out in the form of very fine threads which may be used in the production of handsome silky fabrics. Spun glass can be produced in colors; but on account of the low elasticity of these products, their practical value is small, though the threads are exceedingly uniform and have beautiful luster. Spun glass is used by chemists for filtering strong acid solutions.

A kind of glass wool is produced by drawing out to a capillary thread two glass rods of different degrees of hardness. On cooling they curl up, because of the different construction of the two constituent threads.

Paper Clothing. During the World War, due to the scarcity of cotton and wool, the Austrians and Germans were obliged to use substitutes. Paper was found to be the best and most economical.

The cloth was made of paper yarn. In making paper yarn, the cellulose is transformed into paper, or old paper is used. The manufactured paper rolls often weigh as much as 800 pounds. They are cut into narrow strips from one-eighth inch to six inches wide. These strips are tightly wound into disks. Twisting the strips into round threads is next in order. The German method is this: The disk is contained in a flat holder, and the stripped paper is twisted by two small rolls above the disk. Then the twisted yarn is wound on spools. Sometimes the paper yarn is moistened to make it pliable for twisting, and chemicals are added to give the finished product flexibility, pliability, and durability. The greatest care is exercised in controlling this twisting process. If there is too much tension, the yarn tears; if there is too little, the product is irregular. Therefore the twist gearing is continually readjusted to give the right amount of twist. After twisting, other fibrous materials are woven in. Wastes from cotton and flax are introduced in paper thread. To increase its resistance and to waterproof it, the yarn is automatically passed through a warm bath of mixed glue, tannin, and water glass. Then it goes through a cold bath of aluminum formate and is dried immediately. This treatment does for paper yarn what tanning does for the skins of animals.

Paper clothes can be washed with hot but not with boiling water. They cannot stand machine laundering, but must be hand cleaned or brushed. Acids ruin them; alkalies agree with them. They cannot go through a wringing process, but must be allowed to dry out. They cannot be mangled. They will stand pressing, but it is safer not to iron the borders and folds. On the average, a piece of paper goods or a suit can be washed twenty times.

Not only are clothes made from paper, but several hundred other commodities of daily use. Apartments can almost be fur-

nished with the paper goods now appearing in foreign markets: towels, quiltings, upholstery goods, bed and table linens, curtains, sewing threads, sacks, overalls, raincoats, collars, embroidered blouses, hairpins, hangings for walls, imitations of Persian carpets, and even horses' harness and piping for oil and gas. All of these materials are made from so-called paper yarn — in reality cellulose, which makes up the framework or structure of all vegetation.

QUESTIONS

1. (*a*) Describe the fiber used for rope.
   (*b*) State some of the different hemps and their uses.
2. What are the characteristics of each of the different hemps?
3. How is hemp twine made?
4. What is the difference between jute and hemp?
5. Compare the uses of hemp and jute.
6. (*a*) For what is tinsel thread used?
   (*b*) How is it made?
7. (*a*) What is pineapple fiber?
   (*b*) Where is it found and used?
   (*c*) How is it made into cloth?
8. (*a*) Can pineapple cloth be used in this country?
   (*b*) What objections are made to its manufacture in this country?
9. Describe the manufacture of asbestos.
10. (*a*) What is meant by paper clothing? (*b*) How is it produced?

CHAPTER XXI

KNITTED FABRICS

Notice very carefully the elasticity of hosiery and jersey cloth. This elasticity is not seen to any degree in a serge. Hosiery is a knitted fabric, while serge cloth is woven. Knitting is the second of the fundamental methods of making fabrics, and is distinguished from weaving by the fact that knitted fabrics are made by a single thread, while weaving has two threads at right angles.

Knitting. The terms knitting, netting, and knotting all come from the same Anglo-Saxon root and indicate varying methods of manipulating a single thread for the purpose of producing elastic and pliable fabrics, and the art dates back to the early part of the sixteenth century and probably had its origin in Scotland.

The art and process of forming fabrics by looping a single thread, either by hand with slender wires or by means of a machine provided with hooked needles, is called knitting. Crocheting is an analogous art, but differs from knitting in the fact that the separate loops are thrown off and finished by hand successively, whereas in knitting the whole series of loops which go to form one length or round are retained on one or more needles, while a new series is being formed on a separate needle. Netting is performed by knotting

threads into meshes that cannot be unraveled, while knitting can be unraveled and the same thread applied to another use. Knitting is really carried on without making knots; thus, the destruction of one loop threatens the destruction of the whole web or piece of cloth, unless the meshes are reunited.

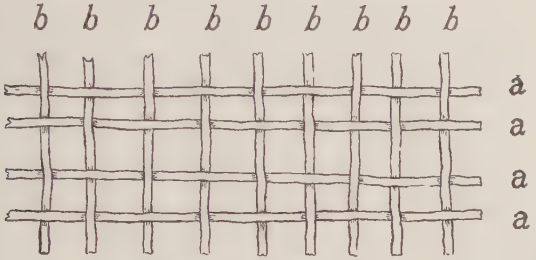
Examine a piece of knitted fabric under the pick glass and notice the construction. How does it differ from weaving? The single thread is formed into rows of loops which hang upon each other, thus giving the knitted fabric its characteristic springiness. Why is such a fabric suitable for underwear? Try to obtain the thread of the knitted fabric and reduce the whole to a heap of yarn by cutting it. Is the yarn intact?

A knitted fabric may be distinguished from a woven fabric by studying the accompanying sketch.

Note that the element of stretch or elasticity, except what lengthwise elasticity may be in the threads themselves, is wholly lacking in the woven cloth. On the other hand, referring to the printed diagram of the knitted fabric, it will just as readily be seen that its very structure implies such a corrugation of its individual loops that if distended by force in any direction its tendency is to return to the normal.

The nature of the loop formed by the knitting needle favors elongation and contraction without marring in the least the general structure of the goods. Builders of looms have at times endeavored to secure this elastic effect by certain manipulations of the mechanism of the loom, but as yet nothing approaching

the product of the knitter has been made. The elastic feature of a knitted texture renders it peculiarly adapted for all classes and kinds of undergarments, for it not only fits the body snugly, but expands more readily than any other fabric of similar weight.



ORDINARY WEAVING

a. Weft. *b*. Warp.

The essential characteristics of good hose are:

1. That they should be without seams.

2. That they should be so knitted as to conform to the foot of the wearer.

PLAIN STOCKING FABRIC

3. That they should be thickened or reinforced where the greatest wear comes.

The essential characteristics of good underwear are:

1. It should be made from elastic cloth, which implies a knitted fabric.

2. It should be porous in a high degree — whether in winter weight or summer weight.

3. The seams should be made upon the most modern sewing machines, with as little bulk as possible.

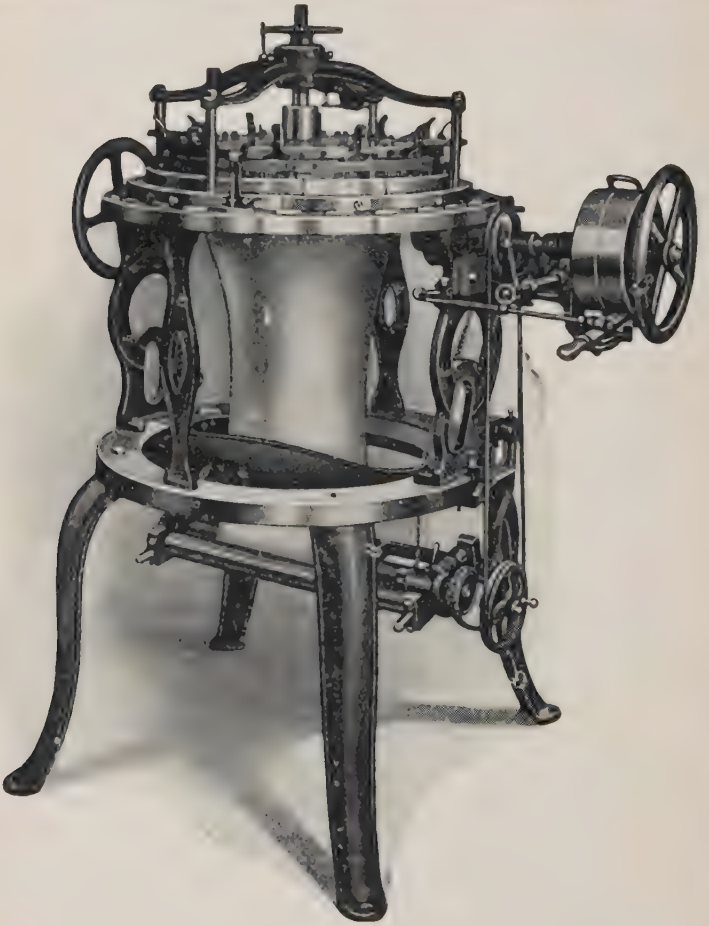
The term " knitted fabric " to many represents the large, open-loop material so often seen in sweaters, etc., but in actuality a knitted fabric may mean one of three-ounce weight (light, flimsy silk underwear fabric) to one of thirty-two ounce weight (compact wool overcoat fabric). This comprehensive range of weights renders knitted fabrics applicable for negligées, waists, dresses, suits, capes, men's overcoats, and in fact almost any class of outer garment. An error often made in judging knitted fabrics is that they are not considered as compact as woven fabrics. While this is true of the large looped knitted material (as in sweaters), most of the silk fabrics manufactured in the piece for outerwear are very closely knitted. The worsted and wool products, which cannot be knitted quite so fine, are put through a certain fulling process to gain that fineness. When finished by this fulling or compressing process, the loose loops become massed together, resulting in a more compact, less stretchable cloth. This compressing can be carried to such a degree that the loops disappear entirely and become one compact piece, distinguishable from a woven fabric only by an expert. There is a wide difference between the knitted fabrics that are produced for the manufacturers of ties, sweaters, scarfs, etc., and the variety of staple fabrics now made into all styles of outer garments. These two industries in the knitting field should not be confused, as they are distinctly different.

Progress of Knitting. Modern appliances for making knitted fabrics are more nearly exact duplications of the original hand processes than is the case with woven fabrics, where, since the introduction of the automatic loom, new principles have been employed and fundamental changes made in the handling of the yarn. The present day knitting machine still uses the same principle which was devised by William Lee of Nottingham in 1859, and the tubular web machine built in 1816 by Brunel is still the model for the circular machine found in modern knitting factories.

In the old days, a worker on the hand frame would produce a few pairs of hose or one or two articles of underwear per day. At the present time one operator can produce up to 150 dozen pairs of army half-hose on a set of machines, while the average production of a set of underwear machines making tubular web is 1000 lbs. weight of fabric per week. A circular knitting machine containing 240 needles and running at a speed of 300 revolutions per minute makes no fewer than 72,000 perfect loops a minute from a single weft thread and knits the yarn at an average rate of one mile in six minutes. A ribbed underwear machine having 24 yarn feeders and having a diameter of 36 inches makes one and a half million (1,500,000) stitches a minute, and will produce 15 inches of fine underwear fabric 64 inches wide in that period.

Knitting Machines. There are various machines for knitting. The circular knitting machines produce a circular web or piece of cloth of various degrees of fine-

ness and in sizes ranging from a child's stocking to a man's No. 50 undershirt. The circular fabric made in



KNITTING MACHINE FOR UNDERWEAR

this manner has to be cut up and joined together by some method to make a complete garment. There

are other machines for producing the finished garment, such as the knitting frame for producing fashioned goods, which makes a flat strip, narrowing and widening it at certain places so as to conform to the shape of the foot, leg, or body. These strips then have to be joined by sewing or knotting to form a garment. Fashioning machines are indispensable for knitting stripes, fancy openwork, and lace hosiery.

There are many kinds of knitted fabrics — some that are plain, others with ribbed effects. Each kind of fabric is made on a special machine; many garments in their make-up include both kinds of knitting; therefore, many machines produce only certain parts of particular garments. In the case of half-hose there is frequently a ribbed top, or in underwear a ribbed cuff, and these may be made either of circular web or full fashioned. In each case the ribbed portion is knit first and then transferred to a plain machine, and being placed upon the needles is worked on to the rest of the garment. In some instances the heel is made by the machine working the leg, though there are numerous knitters specially designed for turning out only this particular part.

Among other knitting machines in modern use are the drawers machine; machines for hose and half-hose with apparatus for making the instep, finishing off the toe, splicing or thickening the heels, etc.; machines for producing the bottoms or soles of hose separately, and also the instep separately; circular stocking machines for producing a tubular web afterwards cut into

suitable lengths for all varieties of hose; circular sleeve machines, circular body machines, as well as circular web machines for making both body and sleeves of undershirts, jerseys, sweaters, etc. Special machines are also made for knitting both plain and ribbed plaited goods, that is, with both sides wool while the center is of cotton, or with a silk or worsted face on one side and the back of an inferior yarn. In the form of auxiliary appliances are produced many kinds of stitching machines: circular latch-needle machines for plain ribbed, mock seam, and striped goods; steam presses; hose rolling machines; hose cutting and welting machines, and many other accessories to hosiery manufacture.

At present fully one third of the knit underwear used in this country is of the ribbed description. It is made in all the materials that the older flat goods are composed of, including silk, silk mixtures, linen, wool, lisle, and cotton. Rib work is ordinarily stronger and more lasting than plain. It is also invaluable for many purposes on account of its tendency to contract and expand in the direction of the circumference without altering its length. This feature makes it indispensable for tops to socks and wrist work for shirts, mittens, gloves, etc., and for the production of heavy garments such as cardigans and sweaters. The expense of knitting rib work is higher than plain knitting, owing to the fact that the machines cannot turn out so great a quantity within a given time.

The formation of the rib in knitted goods is unique in its principle. The effect is produced by reversing

the stitch. In place of making the stitch-work appear entirely upon one side of the fabric, as in plain work, the needles are so arranged that at every alternate row, or two rows alternately, the stitch is reversed, thus making both sides alike. Plain work is done with a single bank of needles, while rib work requires two banks, the function of the second one being to pull and loop the yarn in an opposite direction, thus producing a thicker and more elastic web.

Double work in knitting consists merely in running two threads where one is commonly used. The work is done readily and with but little extra cost for labor. Coarser and heavier needles are required, also a wider gauge for the needle cylinder. Fancy effects in double work are produced by running two colors instead of one. The tendency is for one thread to twine about the other, thus making attractive double-and-twist work. Lumbermen's socks and like goods are often knitted on this plan, though for the most part double work is for the heels, toes, and soles of ordinary hose.

Stripe Knitting. The process of striping knitted fabrics is accomplished automatically by a system of changing the yarns when delivered by the feeds. It has only been within recent years that makers of knitting machinery have been able to offer machines on which more than one kind of yarn could be knit at one time. There are now in use, however, machines that will readily knit several colors of yarn at the same time.

Knitting Cotton. A variety of loosely twisted, four-ply cotton yarn, dyed in various plain and mixed colors,

employed for knitting hosiery, tidies, mats, etc., by hand. It is numbered from 8, coarse, to 20, fine, and commonly put up sixteen balls in a box, each box containing two pounds, manufacturer's weight.

Knitting Silk. A loosely twisted silk thread of domestic manufacture used for knitting mittens, stockings, and other articles by hand. It is also in great demand for crochet work. Knitting silk is put up in the form of balls, each containing one half ounce of thread. It is made in but two sizes, No. 300, coarse, and No. 500, fine; each ball of the former number contains 150 yards of silk; of the latter, 250 yards. No. 500 is manufactured only in white, cream, and black; the No. 300 is fast dyed in a great variety of colors.

Hosiery Manufacture. According to the particular method by which socks and stockings are made, of whatever kind, quality, or material, they are classed as cut goods, seamless, or full fashioned. Of the three methods of manufacturing the first named is the least expensive.

Cut goods in hosiery are made of round webbing knitted on what is called a circular knitting machine. The web has the appearance of a long roll of cloth about the width of a sock or stocking when pressed flat. The first operation consists of cutting off pieces the length of the stocking desired, these lengths, of course, being the same (unshaped) from end to end. The shaping of the leg is effected either by cutting out enough of the stocking from the calf to the heel to allow part to be sewn up and shaped to fit the ankle, or by

shrinking. In the heeling room where the pieces next go, the cutters are furnished with gauges or patterns that indicate just where to make a slit for the insertion of the heel, generally of a different color. When the heel is sewn in, the stocking begins to assume its rightful shape. The toe is now put on and the stocking is practically finished. In the case of socks, the final operation consists of attaching the ribbed top, which tends to draw the upper part of the leg together, thus causing it to assume a better shape. The final work includes scouring, dyeing, and shaping. The cost of making cut goods is less by a few cents per dozen than when knit seamless. While some very creditable hose are produced in this way, yet the presence of the heavy seam is an objection which confines their use to the poorest class of trade. Cut goods are made in all sizes and kinds for men, women, and children.

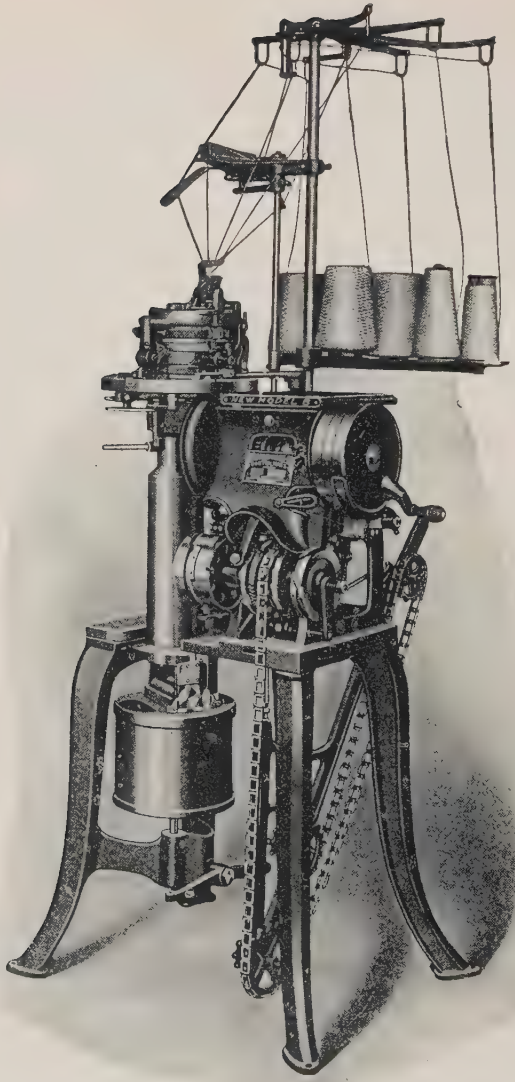
Seamless Hose. Seamless hose are made on a specially constructed machine which produces the entire stocking, but leaves the toe piece to be joined together by a looping attachment. On half-hose the leg is made the same size down to the ankle, but on ladies' hose the stocking is shaped somewhat in the machine. Seamless hose are not, strictly speaking, entirely seamless, inasmuch as all stockings made on a circular knitting machine must have a seam somewhere. There must be a beginning and an ending. In the case of the stocking the ending is at the toe, and the opening left can only be closed with a seam. In some mills this opening is automatically stitched together on special machines;

in others, girls do it by hand with needle and thread. Neither by machine nor handwork can the opening be closed with exactly the same stitch as that made by the needles of the power knitter. However, the seam is of small proportions, and when the goods are scoured, pressed, and finished the presence of the seam is a minor item, as it neither incommodes the wearer nor mars the appearance of the stocking. Seamless goods are made in a great variety of qualities, ranging from cotton half-hose to the fine worsted stockings. A notable and very commendable feature of seamless hose is the socket-like shape of the heel, which fits that portion of the foot as though really made on it. As far as comfort and fit are concerned, the manufacture of seamless hosiery has now reached such a degree of perfection as to bring it second only to the full-fashioned variety.

Full-fashioned Hose. Full-fashioned hose are produced by means of complicated and expensive knitting frames, which automatically drop the requisite number of stitches at the ankle so as gradually to narrow the web down and give the stocking the natural shape of the leg. The toe is produced in the same way, and the shaping of heel and gusset is brought about in like manner. Hence, the goods are called full-fashioned, because so fashioned as to conform to the proportions of the leg and foot. Hose and underwear made by this method are knit in flat strips and then seamed either by hand or machine. Generally, special machines are used, which take up and complete the selvedges, thus avoiding objectionable seams with raw edges.

The knitting frames used for making full-fashioned goods are large, intricate, expensive, and slow in operation; they are difficult to keep in order and require skilful operators. The largest ones knit from fourteen to eighteen stockings at once, using as many as four threads of different colors in the production of patterns. The first operation consists of knitting the leg down to the foot; then the legs are transferred by expert workmen to another frame, which knits the foot. Next they go to another department where, with the aid of a special looping machine, the heels and toes are stitched together. Then the stockings or socks are handed over to expert women operators, who seam up the legs on a machine especially adapted for the purpose. After being sorted they are dyed, boarded, stitched, dried, and finally subjected to heat and pressure to give them a finished appearance. It usually requires two weeks from the time the manufacturing operations begin, for a stocking to emerge from the factory in a finished form. Full-fashioned hose are made in all shades and grades of silk and cotton, in lisle thread, and in all kinds of cashmere, merino, and woolen goods. They are likewise knitted plain, ribbed, and with fancy stripes and embroidery effects. In the United States there are numerous important plants engaged in the production of full-fashioned goods, while large quantities are annually imported from Germany and France.

History. Like many other industries, the knitting trade owes its first and most important impetus to the genius of one who was not connected with the business



KNITTING MACHINE FOR HOSIERY

in a practical way. This event occurred when the Rev. William Lee invented the hand frame. He was married early in life, and his wife was obliged, on account of the slender family finances, to knit continuously at home. Struck with the monotony and toil involved in knitting with the hand pins, Mr. Lee evolved a means of knitting by machinery and brought out the hand stocking-frame, which to-day preserves its chief features very much as Lee invented them. When knitting by hand, one must form each loop separately, and loop follows loop laboriously until the width of fabric has been worked. Lee contrived to make the whole row of loops across the width simultaneously by arranging a needle for each loop and placing in connection with each needle a sinker and other apparatus for completing the formation of the loop. First of all, the yarn is laid over the needles, which are arranged horizontally, and the sinkers come down on the yarn and cause it to form partial loops between the needles. The old loops of the previous course are now brought forward and the new yarn is drawn through them in the same way as is done on the hand pins. Thus the new yarn of one course is drawn through the loops of the preceding one, and so the whole fabric is built up. This frame of Lee's held its own in the great centers of the industry until some forty years ago.

Lee's hand frame gave way to what is termed the jack and sinker rotary frame, which was like the hand frame in its chief features, but with the advantage that all the motions were brought about by power.

The various operations were put under the control of a set of cams [1] and made to perform their movements in exactly the same way as in the case of the hand frame. In the first power machine for knitting, the machine builder used the cam mechanism, and in examining the latest machines we find that he has persisted in this course throughout. The cam movement is characterized by great smoothness of working and absence of vibration, which is very necessary in a machine of the delicate adjustment of the knitting frame. It is usual to connect some of the parts with two of these cams, one of which controls the up-and-down motion and the other the out-and-in movement. When these two cams work in conjunction, we obtain all the possible degrees of harmonic motion.

From the jack and sinker frame the next really important step was taken when William Cotton brought out his famous Cotton's patent frame. In his machine the frame was in a sense turned on its back, for the parts, such as the needles, which had been horizontal, were made vertical and *vice versa*. He also reduced the number of the moving parts and perfected the cam arrangement. Another very important development of the machine was a subdivision of the parts so as to work a number of articles side by side at one time. At present there are knitting frames which can make twelve full-sized garments at the same time.

Another important improvement was effected when

[1] A cam is a device consisting of a special shaped wheel attached to a machine to give a special kind of motion or movement.

the fashioning apparatus was supplied to the machine, by means of which the garments could be shaped according to the human form by increasing or decreasing the width as desired.

Finishing Process. When socks and stockings are taken off the knitting machines, they present an unfinished appearance, being loose, puckered, dirty, and generally shapeless. Scouring, dyeing, shaping, and pressing serve to improve their appearance, and these finishing operations are a distinct branch of the industry. While still in a moist state, the hose are shaped. This is effected by the use of forming-boards made of wood and about one half inch in thickness. The sock or stocking is carefully stretched over the "form" while damp, and then placed in a heated chamber and allowed to dry. The goods assume the shape of the wooden "form," and will always hold it if the work has been carefully and thoroughly done. After they have been taken from the drying chamber and the boards removed, the hose are pressed between heavy metal plates or rollers, looked over for defects, and when boxed or bundled are ready for market.

Materials. Woolen, worsted, cashmere, and merino yarns are the chief materials used in the manufacture of wool hosiery. *Worsted* differs from *woolen* yarns by being spun with more twist from fiber which has been combed as well as carded. Combing removes the shorter fibers and places the remaining long fibers in a more nearly parallel position, producing a yarn with smoother finish. *Cashmeres* are worsted yarns with

a woolen finish (French system). They have the smoothness and regularity of worsteds combined with the softness and fullness of woolens. *Merino*, a term well known in the trade, when applied to yarn or manufactures of yarn means a mixture of wool and cotton spun together in the yarn.

Besides the familiar use of cotton and wool in combination, the vogue for fancy hosiery has brought about the introduction of a silk and wool mixture which gives a pleasing effect, not only because of the difference in the luster and texture of the materials, but also because of the various color combinations obtainable by dyeing the article after it has been knitted. Frequently different materials are introduced into the article by plating, a process whereby two yarns are knit simultaneously in such a manner that one is constantly on the face of the fabric and the other on the reverse. This method is sometimes employed with yarns of varying quality to produce an article of superior appearance at a moderate price, as when cotton and wool or cotton and silk are combined, giving the outside of the garment the appearance of being all wool or all silk to a greater extent than if the fibers were mixed in the yarn. Such an article can be produced and sold for much less than one of all silk or all wool. However, plating may be used to secure effects as well as for purposes of economy. Frequently silk and wool in different colors are so combined.

Heather, a diffused mixture of colors in the yarn, but not necessarily a mixture of materials, is used in wool hosiery and in cotton made to resemble wool.

The description of materials used for wool hosiery and for wool knit fabrics applies also to these branches of the industry. The worsted yarn used in this fancy knit goods industry ranges in count from 3's to 2/80; the wool from 8's to 2/23, and the merino from 8's to 2/23. Besides these yarns there is a considerable amount of mohair, beaver, and llama hair used.

The following silk yarn is used for hosiery:

Raw silk of 13/15 denier size doubled and twisted into 10 or 12 thread tram or hosiery yarn, of $2\frac{1}{2}$ to 5 turns twist per inch, is used for hosiery much more extensively than spun silk which, because of its inferior strength and elasticity, is less satisfactory for knitting although frequently used in seaming. A two-thread tram having greater twist, as much as eight turns to the inch, is knitted into a fabric from which gloves and light-weight underwear are cut. Knitted ties are made from low grade raw silk of 10 to 15 ends united by a slight twist. The high cost of raw silk has somewhat lessened the demand for these articles.

The following are the principal varieties of knitted fabrics:

Balbriggan. A knitted fabric used for underwear, made of Egyptian cotton, unbleached. This cotton has an attractive color in the grey and is very strong. Substitutes are offered of cheaper cottons dyed to resemble the original article.

Balbriggan underwear originated in the town of Balbriggan, Ireland. Here, in 1845, was first started the manufacture of a fine class of full-fashioned hosiery from unbleached cotton, made from carefully spun yarn, and in both medium and very fine grades. The goods obtained a great celebrity on account of their sterling qualities, and the manufacture still continues at Balbriggan, though on a comparatively small scale. Since about 1860 balbriggan underwear has been pro-

duced largely in England and America. The distinctive feature of this style of goods is the peculiar treatment to which the cotton is subjected in preparing it for spinning. The process is similar to that employed in making worsted yarn from wool. Combed yarns spun from long staple cotton are principally used in the production of balbriggan. Egyptian or Maco cotton is the chief material, and its tawny shade accounts for the color of most natural balbriggan. The yarns, though somewhat coarse, are smooth and quite free from the fuzziness characteristic of yarns spun from short staple cotton by the carding process; consequently, the knitted fabric does not mat together and is more elastic and pleasanter to wear than a texture constructed of carded yarns.

Originally, balbriggan underwear was made only in the full-fashioned style and was very expensive. To France belongs the credit of popularizing the goods by the introduction of what is now commonly known as French balbriggan. The knitted material was constructed of the same class of yarn — combed long staple cotton, — but it was produced on circular machines run by power, and the tubular fabric was cut and sewed. This represented a much less costly mode of manufacture than by the fashioning hand-frame, and thus garments composed of the same class of yarns, when made in the French way, could be sold at a far lower price. These goods have never ceased to grow in popularity and are now extensively made in very light, medium, and heavy grades. Balbriggan under-

wear in both the full-fashioned and French styles is produced in immense quantities in the United States.

Cashmere underwear is the name given in trade to a variety of winter goods knitted of fine worsted yarns, particularly of yarns spun from Saxony or other fine, soft wools.

Fleece-lined underwear is a variety of heavy-weight goods especially adapted for winter use, and produced in cotton, wool, and merino. Fleece-lined undergarments were first introduced in 1870, since which time they have steadily grown in popular favor. The distinctive feature of this style consists of the nap, more or less dense, which is raised up on the inner side of the garments. The nap adds softness to the fabric and makes it seem more woolly, even though the texture is composed entirely of cotton. It is claimed by the advocates of this class of goods that an important sanitary principle is involved in the use of fabrics finished with a fleece on the inside. As an illustration of this principle, attention is called to the coat or covering of fur-bearing animals. It is pointed out that in the same manner as the fur allows the perspiration of the body of the animal to exhale without difficulty under all conditions of temperature, accurately adjusting itself to the various changes, so does the fleece placed next to the human skin allow the pores to do their regular work without hindrance, and as in the case of fur, insures an even temperature for their delicate functions. Through this fleece the perspiration passes, and the moisture is readily absorbed by the fabric on which the fleece is

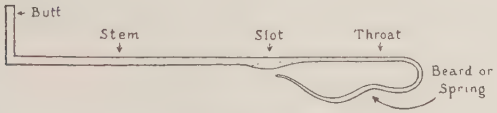
made, and from this it readily evaporates in the usual manner. In this way, it is claimed, the natural functions of the skin are not disturbed by the fleece-lined underwear as they are by a dense mass of wool or cotton lying immediately upon the pores, tending often to stop their action.

Jersey Cloth. A knitted fabric used for dresses, suits, sweaters, blouses, sport garments, underwear, etc. It may be made of wool, cotton, or silk. Since it is knitted, it is made of soft spun yarn and is elastic but not rigid, and therefore does not hold its shape well and is not considered " dressy." It may be easily napped and is usually composed of yarns in colors. Because it is elastic, it clings well to the figure, does not wrinkle, and does not become shiny, due to the unevenness and nappy surface. The prices vary according to composition, kind of yarn, and finish.

Lisle Thread underwear is a light-weight cotton variety, especially adapted for summer, made in both full-fashioned and cut goods. Lisle yarn is spun from long staple Egyptian cotton, prepared by the process of combing. The yarn is extremely fine, hard twisted, and compact, and is usually gassed to give it a smooth, clean surface. Garments made of lisle yarn, or thread, are exceedingly light and cool, and do not become soggy from perspiration as do those made from the spongy carded yarn. Each fiber of the combed thread retains its separateness, and there is no tendency to felt; consequently the fine, smooth threads slide and slip in their meshes, thus giving great elasticity to the whole garment.

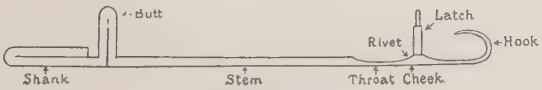
Merino is the name given to underwear knitted of yarn containing equal parts of cotton and wool; in color it is chiefly confined to white and shades of grey and brown. Merino underwear is made in summer and winter weights, and in full-fashionedand cut goods.

Plated underwear is a style of knitted goods the



SPRING NEEDLE
Used for fine fabrics.

fabric of which is composed of a layer of fine fiber for the surface, and a layer of coarse or inferior fiber for the back or interior portion. Garments of this kind may be knitted with both sides of wool while the center



LATCH NEEDLE
Used for coarse fabrics.

is of cotton, or with a silk or worsted face and the back of cotton. Usually, plated underwear is made by combining a silk face with a cotton back.

Other Knitted Garments. Knitted fabrics were originally used for hosiery and underwear, but to-day they are also employed for outerwear, for golf suits, skirts, all kinds of headgear, neckties, scarfs, and almost all kinds of sport garments.

Types of Machines. There are two kinds of knitting machines: circular and flat. The circular machine has the needles arranged in circles and naturally produces a circular or tubular fabric, such as a stocking, underclothing, bathing suit, etc. The flat machine has the needles arranged in a straight line and consequently produces a flat fabric. Each of these machines is equipped with one of two types of needles — a latch needle or a spring needle.

Knitting machines have been so improved that fabrics produced on them may have practically all the desirable characteristics of woven goods, with the advantage of cheaper production, because they can be made four or five times as quickly, and therefore labor and over-head items are smaller per unit. Some fabrics, such as jersey cloth, are made on circular machines with either latch or spring beard needles.

The most recent development of fabric knitting, and that most likely to gain in importance, is the warp-knitting machine, of which there are many varieties. These are flat spring needle machines of very fine gauge, producing a fabric of extraordinarily even texture. Milanese and tricot, the best known warp knitting machines, are imported from England and Germany or, in some instances, built in the knit goods factory.

Knitted Goods Contrasted with Woolen Fabrics. Knitted goods differ primarily in structure from woven fabrics in being made of one thread or one series of threads traversing the fabric in one direction, either across the fabric, which is weft knitting, or lengthwise

of the fabric, which is warp knitting. The structure of the fabric in either case is made up of connecting loops formed on needles. A weft-knit fabric is made from one or more weft threads traveling from needle to needle, forming adjacent loops and returning as another series of loops. Each row of loops across the width of the fabric forms a *course*, each row in the length a *wale*. Warp fabrics are knitted from any number of threads arranged on a beam as are the warp threads for a woven fabric, but instead of the texture being built up by the crossing and recrossing of another series of threads, the warp threads only, running longitudinally, make up the knitted fabric. If one needle were to operate continuously on the same warp thread, a number of chains would be formed, but each thread is controlled by a guide which lifts it back and forth from one needle to another, interlocking the loops of the different threads in such a manner that a continuous fabric results. It will be seen that color variation in weft fabrics can most easily be secured by introducing the different yarns in the formation of the length to produce horizontal stripes. In warp-knitted fabrics an indefinite number of color combinations is possible by the distribution of the yarns on the warp beam, which will effect stripes longitudinally. Further designs can be attained by changes in the manner of shifting the threads from needle to needle.

Types of Weft-knitted Fabrics. The texture and appearance of knitted fabrics can be considerably changed by stitch selection and stitch formation. There are

three general types of weft-knitted fabrics: (1) plain, (2) ribbed, and (3) purled. In a plain weft-knitted fabric the sides of the loops all lie on the face of the fabric, giving the lined appearance of the wales, and the loop ends all lie on the back of the fabric. Two sets of needles, operating in different planes and so forming loops on opposite sides of the fabric, produce an emphasized appearance of the wales or groups of wales, which because of this prominence are called *ribs*. Some of the ribs appear on the face of the fabric and some on the back, according to the number of needles in each plane. If one wale appears alternately on the face of the fabric with one on the reverse, the fabric is known as a 1 and 1 rib. The number of wales showing on either side of the fabric may be grouped; as, for example, 2 on one side and 1 on the other, or 5 on one side and 3 on the other, forming respectively, a 2 and 1 and a 5 and 3 rib.

Purling or pearling is effected by reversing consecutive stitches in a course, so that loops which would normally appear upon one side of the fabric will occur upon the other. If a fabric is purled at alternate courses, raised lines will appear running horizontally. As the greatest contraction is in the length, so the greatest elasticity is in that direction, just opposite that of ribbed fabrics.

Modifications of these Types. These three types of fabrics — plain, ribbed, and purled — may be modified by the use of different kinds of stitches. One of those most frequently seen is the tuck stitch, formed

by the retention of one or more loops in the needle before the completion of the stitch. This results in greater prominence at the stitches tucked, giving more elasticity and bulk. Tucking is therefore used not only for the design obtainable, but also where the greater stretch of a heavier fabric is desired. An extra bulk is obtained by applying the tuck stitch in the ribbing process. The *cardigan* rib is the alternating of plain and tuck stitches on both the ribs of the face and those of the back of the fabric. The *half cardigan*, or royal rib, is formed by knitting one series of the ribs plain and the other series alternately plain and tucked. These stitches are so frequently used for heavy knitted coats that "cardigan jacket" has become a common term.

Classes of Warp-knitted Fabrics. Warp-knitted fabrics may be divided into two general classes: (1) close fabrics and (2) open fabrics. Close fabrics, as the term implies, are those in which the loops are intimately interwoven, giving a compact texture. The increased thickness obtained by ribbing and tucking in weft-knitted fabrics may be imparted by knitting several series of warp threads simultaneously, whereby a fabric of double thickness is secured. An open fabric is one in which the warp wales are connected only at intervals. Warp-knitted fabrics vary in texture from the heaviest overcoating to the most diaphanous nets.

Properties and Uses of Weft-knitted Fabrics. The unique characteristic of weft-knitted fabric, its horizontal stretch, while making it unsuitable for some purposes, adapts it to others, most especially for clothing

to be worn next to the body, where a smooth, snug fit is desired. The tensile properties of warp-knitted fabrics lie midway between those of weft-knitted and those of woven fabrics. Because of the sidewise interlocking of the loops in a warp-knitted fabric, it is much less elastic on the width than weft-knitted fabrics; hence not so well suited to use for close-fitting undergarments, but more useful for outerwear. These fabrics are somewhat elastic, but the stretch is less excessive than in weft-knitted fabrics and more equal as to length and width. They are particularly desirable for gloves, allowing a slight conformity to the shape of the hand without danger of undue bagginess. Warp-knitted fabrics are much used in making cotton gloves. For gloves cut from woolen fabric, jersey cloth made on weft machines is very serviceable, as wool has more natural elasticity than cotton and will not remain in the shape to which stretched.

Substitutes or Competing Articles. Where woolen knitted fabrics are used for underwear, they encounter, to some extent, competition from woven flannel, but apparently this competition is not very serious, as the knitted underwear can be made to fit better and is more comfortable, as it yields readily with the movement of the body. Warp-knitted fabrics have much the same uses as woven fabrics, and when these are of similar material and weight they are competitive. Serges, tricotines, and heavy coatings are more and more being replaced by warp-knitted fabrics. For coatings the warp-knitted fabrics are frequently napped so that

the loop formation is not apparent. Warp-knitted fabrics and weft-knitted fabrics are somewhat competitive, as in the case of the weft-knitted jerseys, which are used for suits and dresses, or the lighter weight jerseys used for gloves.

Knitted goods for outerwear have increased to such an extent that they are the standard for ready-to-wear clothing, and even for the use of the dressmaker. The common knitted outer fabric of fine texture of different qualities and used for dresses, also in heavier weights for overcoats and suits, is called jersey cloth. Special names are not given to all knitted fabrics, but they are frequently named after the fabric they resemble in finish and weight.

Growth of the Knitting Industry. The knitting industry in 1912 had 345 enlarged knitting machines; to-day there are over 160,000 large machines. This rapid growth is due to the following facts:

(1) A knitted fabric can be made in one seventh the time required to produce a woven fabric of equal merit.

(2) Quickness of production lessens the cost of manufacture.

(3) Knitted fabrics for outerwear have style and wearing qualities to meet the demand of the public.

The first knitted outer cloth appeared in America from England as jersey cloth in 1878. It met with immediate approval and was in vogue for three years; then it disappeared. Since 1912 it has been made in America and has become popular.

In 1914 a knitted fabric resembling a serge, but with

the rib effect of hosiery, was placed on the market and became very popular.

Knitted fabrics in Jacquard design were produced in 1922, with the result that to-day designs of any description (floral, ornamental, etc.) are being manufactured. This late accomplishment is significant, because it consummates the last rung in the ladder to bring the knitted fabric industry up to the attainments of the much older textile industries. This opens up an entirely new field for knitted fabrics and promises to lead the way to their future predominance.

QUESTIONS

1. (*a*) Compare the characteristics of a woven and a knitted garment.
   (*b*) Explain the differences.
   (*c*) Explain the differences as regards structure.
2. What is knitting? crocheting? felting?
3. Draw a sketch showing the difference between a woven and a knitted piece of cloth — interlacing, interlooping, etc.
4. Explain the meaning of the term "knitted fabric."
5. (*a*) Give briefly the history of knitting.
   (*b*) Compare the production of hand and power knitted cloth.
6. (*a*) Explain the circular knitting machine.
   (*b*) What fabrics are made on it?
7. (*a*) Describe the making of ribbed fabrics; of striped knitted fabrics.
   (*b*) Describe the making of full-fashioned hose.
8. Tell briefly the history of the knitting machine.
9. Are knitted fabrics as compact as woven fabrics? Prove your statement.
10. Define: Balbriggan; jersey cloth; merino underwear; fleece lined; cashmere; lisle thread underwear.

11. Describe the flat knitting machine. What kinds of fabrics does it make?

12. Tell of the different kinds of yarns that are used in knitting.

13. Describe the opportunities for knitted fabrics for outer wear.

14. (*a*) Define the following: warp knitting; filling knitting.
(*b*) State the advantages of each.

15. Describe the following: course; wale; purled.

16. Describe the three different kinds of filling (weft) in knit fabrics.

17. Describe the two general classes of warp-knit fabrics.

18. What are the properties and uses of a filling (weft) knit in fabric?

19. Describe briefly the growth of outer garment wear of knitted fabrics.

CHAPTER XXII

PLAITED FABRICS

Fabrics made by the interlacing of a single thread with considerable freedom, so that the interlacing can take place to form a design or pattern, as in the case of lace, are called plaited fabrics.

Lace. Lace is the name applied to the ornamental open work of threads of flax, cotton, silk, gold, or silver, and occasionally of mohair or aloe fiber. The latter are used by the peasants of Italy and Spain.

The word "lace" is sometimes used in a general sense to cover an article of a lacelike character, such as Barmen lace, which is a fancy braid, and Plauen or burntout lace, which is made by embroidering on a foundation material that is afterwards removed by flame or chemicals. Technically, however, the lace machine is the only machine that produces lace; no article produced by braiding, knitting, weaving, or embroidering, can correctly be termed lace.

Lace consists of two parts, the ground and the flower, and may be made by either hand or machine.

Handmade lace is of two kinds — (1) needle lace, made with a single needle and thread, each opening, called a mesh, being completed as the work progresses, and (2) pillow or bobbin lace, made with many threads,

each thread being twisted about another and then carried on to the next mesh before the completion of the first. Lace made by hand is called "real" or "point" lace in distinction from machine-made lace, sometimes called "imitation lace."

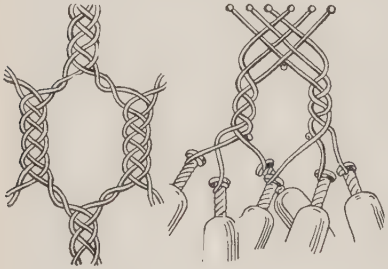
Whether of needlepoint or pillow make, both the ornament and the ground are produced by the lace maker. *Needlepoint* is made by first stitching the net with thread along the outline of a pattern drawn on paper or parchment, thus producing a skeleton thread pattern. This threadwork serves as a foundation for the different figures which are formed in the lace.

Bobbin or *pillow* lace more nearly resembles weaving. The threads are fixed upon a circular or square pillow, placed variously to suit the methods of manufacture in vogue in different countries. The object of using the pillow is to prevent too much handling of the lace. One end of each thread is fastened to the cushion with a pin, the main supply of thread being twined around a small bobbin of wood, bone, or ivory. The threads are twisted and plaited together by the lace maker, who throws the bobbins over and under each other. The operation is fairly simple, since children of eight or nine years of age can be trained to it successfully. It demands, however, considerable dexterity with the fingers.

The design for pillow lace must of course be adapted to the technical requirements of the process, and cannot therefore be the same as one for needlepoint, which has a better appearance and greater strength than pillow lace. For this reason it was in former times

generally preferred for wear on occasions of state. On the other hand, pillow lace has the quality of charming suppleness, and for use in mantillas, veils, and fichus it is better than needlepoint, lending itself with delicate softness and graceful flexibility as a covering for the head and shoulders of women.

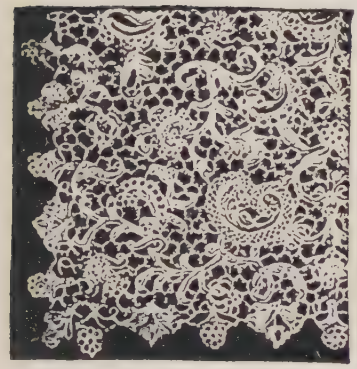
Manufacture of Modern Lace. Modern lace is chiefly made by machinery. Lace machines are costly and complicated mechanisms. The fancy-lace machines especially must be very carefully made and adjusted, since they are used to make lace by intertwisting 12,000 to 30,000 threads at a time. Usually four sets of threads are employed, — weft or bobbin threads, ground-warp threads, outline threads, and gimp threads. The bobbin and ground-warp threads form the body of the lace, while the outline threads define small figures that are filled in by the gimp threads. The ground-warp, outline, and gimp threads are carried on warp beams. The bobbin threads are wound on the circumference of minutely thin disks that are carried in equally thin steel chariots.



MESH OF BRUSSELS PILLOW LACE, Magnified

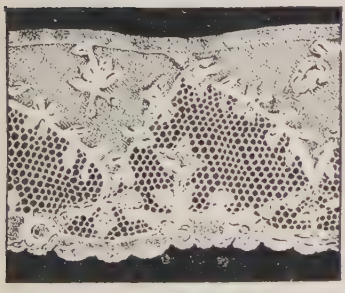
DIAGRAM SHOWING BOBBINS IN USE

In the operation of the machine, lace is " made " on the lace beam, at the top of the machine, by the interlacings of weft and warp as a long line of thousands of the thin steel chariots swing pendulum-like back and



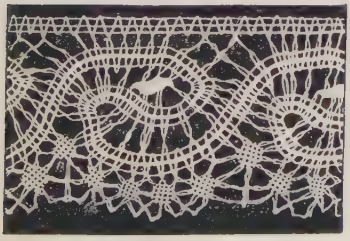
VENETIAN NEEDLEPOINT
18th. Century

VENETIAN NEEDLEPOINT
17th. Century



PILLOW-MADE BRUSSELS
18th. Century

PILLOW-MADE BRUSSELS
17th. Century



HAND-MADE CLUNY

FRENCH VALENCIENNES

forth in an unbroken line through the shifting mazes of the vertical warp. The chariots are guided by grooves in two long comb bars, one at the back and one at the front of the machine; the " well," or long narrow space between the parallel bars, being occupied by the warp. The warp threads are controlled by thin steel strips operated by a Jacquard attachment. At each forward or backward swing of the chariots carrying the bobbin threads, the warp threads are shifted one or more spaces to right or left, alternately, and the crossings are pushed up into place by point bars.

Two Types of Machines. The two general types of the fancy-lace machine are " levers, with lean bars" and " levers go-through." These are very similiar, but in the first and older type the chariots in swinging from one comb bar to the other land on brass sliding bars, while in the latter they slide into the combs directly. The " levers go-through " is the most popular, as it can be operated at higher speed and gives a greater production, except for very complicated work.

Fancy lace is made in narrow strips. For instance, if lace two inches in width is to be made on a machine 222 inches wide, it is made in 111 identical strips simultaneously. The different strips lie side by side, connected only by binding threads that are afterwards clipped.

Lace Terms Defined

Alençon (*Point d'*). A fine needlepoint lace with the ground of double-twist thread in a semi-net effect. Is usually worked with horsehair on the edges to give firmness to the cordonnet. Named for the city in France where it is made.

Allover. A name for all wide laces used for flouncing, yokes, and entire waists. Usually the lace is over eighteen inches wide.

American Laces. A general term formerly used to distinguish lace made in this country, the development of the industry having now rendered the term nearly obsolete.

Angleterre (*Point d'*). A fine Brussels pillow lace, distinguished by a rib of raised and plaited threads worked in the lace. Shown in floral, ornithological, and geometrical designs.

Antique. A hand-made pillow lace of heavy linen thread in a large, open, rectangular knotted mesh. Used for curtains, bed sets, draperies.

Antwerp. A bobbin lace, resembling early Alençon. Shows a "pot" — that is, a vase or basket effect — in the design.

Appliqué. Any lace in which the body and the design are made separately. The body is usually silk and the design cotton or linen.

Appliqué Brussels. A name sometimes given to Brussels appliqué laces.

Arabe (*Point d'*). A coarse bobbin lace made in Belgium and France as well as Arabia. Shows a large, bold pattern, cable edged, and is almost invariably in a deep écru tone. Used for curtains and draperies.

Arabian. Same as above.

Argentine. Similar to Alençon, the mesh being a trifle larger.

Arras. A very strong, inexpensive, white bobbin lace, of simple pattern, somewhat resembling Mechlin. Distinguished by its light, single thread ground. Named for the city in France where it is made.

Aurillac. Somewhat resembles Angleterre. Bobbin lace made in Aurillac, France.

Auvergne. Any kind of bobbin lace made in Auvergne, France. Different makes and patterns.

Ave Maria. A narrow edging lace.

Baby Lace. A light and simple edging lace made in England.

Battenberg. The same as Renaissance. Designs confined to flower patterns.

Bayeux. A bobbin lace, usually an imitation of Spanish point.

Also a black, rich lace made in large pieces for shawls, head scarfs, etc.

Binche. A fine pillow lace, without cordonnet. Ground resembles a spider-web with small dots. Made in Binche, Belgium.

Bisette. A coarse, narrow French peasant lace in simple designs. Name often applied to cheap bordering laces.

Blonde. So called, being originally a bobbin lace made of unbleached silk, though now shown in black, white, and colors. Made with two different sizes of thread; fine thread for the ground, coarse for the design. Usually takes some floral form. Very lustrous.

Bobbin Lace. Imitation of pillow lace. Made in England and France.

Bobbinet. The same.

Bone Lace. An obsolete term once given to Honiton bobbin lace.

Bone Point Lace. Applied to laces having no regular ground or mesh, such as Renaissance.

Border Lace. Practically synonymous with edging.

Bourdon. A machine lace made of both silk and cotton. Show scroll-like patterns cable-edged on a regular mesh. Usually dyed black, but sometimes bleached. The outline is of a heavy lustrous thread. Used chiefly for dress trimming and millinery.

Brettone. A cheap narrow edging.

Bride Lace. A lace with the pattern connected with brides. Same as bone point lace.

Brides. Slender threads connecting different parts of a pattern.

Brussels Net. A plain net made originally in Brussels, but now produced in all lace manufacturing countries.

Brussels Pillow. A fine pillow lace with the patterns joined together by little loops on their edges.

Brussels Point. Shows an open pattern, made partly in open, partly in closed stitch, giving the appearance of shading.

Carrickmacross. Tiny Irish cambric drawn work, appliqué on net.

Cartisane. A guipure or passementerie made with thin silk or gilt-covered strips of parchment.

Chantilly. A pillow lace very similar to blonde. Comes from Chantilly, France. Made in both silk and cotton and usually

in black. Non-lustrous, and looks as if made from black linen thread.

Chiffon Lace. Chiffon embroidered in twist silk.

Cluny. A coarse-thread bobbin lace, made in both linen and cotton. Shows a close-stitch pattern darned on an open ground. Used for dress trimmings and the manufacture of curtains. Hand-made Cluny is more durable and more beautiful than machine made.

Cork Lace. A sweeping term used to designate all laces of Irish make.

Cotton Lace. All lace made of cotton.

Craponne. A cheap, stout thread furniture guipure.

Crochet Lace. Any point lace made with the crochet hook.

Darned Lace. A comprehensive term taking in all net effects with the pattern applied in needlework.

Devonshire Lace. A lace made in this part of England, and especially Honiton imitation.

Dieppe. A fine needlepoint lace made in Dieppe, France. Resembles Valenciennes. Made with a regular ground of squares of small meshes alternating with open squares upon which the pattern is applied in close stitch.

Duchesse. A pillow lace with fine net ground with the patterns in raised work, volants, and the like.

Dutch Lace. Practically a coarse Valenciennes.

English Point. See Angleterre.

Escurial. A heavy silk lace made in imitation of Rose Point. Patterns outlined with cable edge.

Esprit (Point d'). A dotted bobbinet with the dots either singly or in clusters.

Filet. A square mesh linen lace, made of many grades of yarn, some very fine, others quite coarse. The patterns are made by weaving the thread in and out of the meshes. Hand-made filet has a single thread. Machine made filet has a double thread. The finer the yarn, the more expensive is the lace. The lace is used on waists, dresses, underwear, etc. The hand-made lace is more durable than the machine-made.

Flemish Point. A needlepoint lace made in Flanders.

Footing. Simple insertion of Brussels net from one to three inches in width.

Galloon. Irregular band with a fancy edge. Entire piece often in zig-zag or scallop form.

Genoa. A heavy lace made of aloe fiber. Another name for macramé.

Gimp. See Guipure.

Gold Lace. Gimp or braid covered with gold or imitation gold thread.

Grammont. A white pillow lace used for shawls and the like; a black silk lace nearly resembling blonde.

Guipure. A fancy trimming of wire cord whipped round with silk or cotton threads, and the small patterns stitched together.

Guipure d'Art. Linen net upon which raised intersecting patterns are worked.

Guipure de Flanders. A pillow lace made separately, having flowers connected by bars and brides.

Hand Embroidered. A heavy point lace, usually of Plauen manufacture, with fancy floral or other figures embroidered on the design.

Honiton. An English bobbin lace, famed for the beauty of its designs. Named for the city where it was first manufactured. Now made in Belgium, Holland, and France. Sprays sometimes made separately, and then worked on a net — Honiton appliqué.

Honiton Braid. A narrow machine-made braid of ornamental oval figures connected by narrow bars. Used for collars, handkerchiefs, and tidies.

Honiton Guipure. A large flower-pattern lace on very open ground, the sprays held together with brides or bars.

Imitation Lace. A term used to designate any machine-made lace in contrast with hand-made.

Insertion. Any narrow lace with a plain edge on either side that admits of its being inserted in a fabric.

Irish Crochet. A heavy hand-made lace, remarkable for the beauty and distinctness of its patterns, and the startling whiteness of the linen thread used in its manufacture.

Irish Lace. A general term used to designate all lace made by the Irish peasantry.

Irish Point. A hybrid combination of appliqué, cut work, and

embroidery on net with elaborate needle stitching in the higher grades.

Irish Trimming. A simple, woven lace, used on white wear.

Knotted Lace. Frequently referred to as knotting. A fancy weave of twisted and knotted threads in close imitation of some old hand laces.

Lille (also *Lile*). A French lace named after the town where it is made. Somewhat resembles Mechlin. Shows a very clear, light ground and is the most beautiful of all simple thread laces.

Limerick Lace. A form of embroidery on net or muslin.

Luxeuil. A general term for hand-made laces of Luxeuil, France. More specifically those of a stout, heavy nature. Used for tidies, curtains, draperies.

Macramé. A knotted hand-made lace, made of a very heavy cord. Shown principally in geometrical designs. Very popular in deep écru.

Maline. A fine silk net. Sometimes also applied to Mechlin lace with a diamond mesh.

Maltese. A coarse machine-made cotton lace, resembling torchon. Has no regular ground, the patterns being usually connected with heavy stitch work.

Mechlin. A light pillow lace with the pattern outlined by a fine but very distinct thread or cord. Real Mechlin generally has the ground pattern woven together, the latter running largely to flowers, buds, etc.

Medallion. A single, detached pattern.

Medici. A special kind of torchon edging, with one edge scalloped.

Mélange. A hand-made silk pillow lace, showing a combination of conventional Chantilly with Spanish designs.

Mignonette. A light bobbin lace, made in narrow strips. Resembles tulle.

Miracourt. Sprig effects of bobbin-lace applied on net ground.

Mexican Drawnwork. Little round medallions either single or in strips, the threads drawn to form a cartwheel. Mexican and Teneriffe drawnwork are practically the same. Machine imitations made in Nottingham, Calais, and St. Gall.

Motif. See Medallion.

Nanduly. A South American fiber-lace, made by needle in small squares, which are afterward joined together. Design very beautiful and of remarkable durability.

Needlepoint Lace. See Point Lace.

Normandy Lace. See Valenciennes.

Nottingham. A general term including all the machine-made laces turned out in that great lace-producing center of England.

Oriental Lace. Really an embroidery, being produced on the Schiffli machine, the pattern being then either cut or eaten out. Also applied to point d'Arabe and certain filet effects.

Oyah Lace. A crocheted guipure shown in ornate patterns.

Passementerie. A decorative edging or trimming, especially gimp or braid.

Picots. Infinitesimal loops on brides and other strands.

Pillow Lace (*Bobbin Lace*). Made on a pillow with bobbins and pins. Machine-made imitations retain the name.

Plauen. A term applied to all laces emanating from that section of Saxony and including imitations of nearly all point laces, which are embroidered on a wool ground, this being afterward dissolved in acid and the cotton or silk design left intact.

Point de Gaze. A Flemish point lace resembling point d'Alençon, though much softer, being without horsehair.

Point de Gêne. An openwork embroidery made on a wool ground which is afterwards eaten away by acid.

Point d'Irelande. A coarse machine lace, made in imitation of real Venetian point.

Point de Milan. A variety of guipure, having a ground of small meshes, and a pattern consisting of bold, flowing scroll devices.

Point de Paris. A variety of cheap machine lace, cotton, of simple design.

Point Kant. A Flemish pillow lace, with a net ground and the design running largely to " pot " effects — pot lace.

Point Lace. Lace made by hand with needle and single thread. Needlepoint the same. Point d'Alençon, point de Venise, etc., are all variations of point lace and will be found classified under their initials.

Point Plat. Point lace without raised design.

Renaissance. A modern lace, made of narrow tape or braid formed into patterns, held together by brides, the brides forming subsidiary designs. Battenberg is the same thing.

Repoussé. Applied to the design, being a pattern that has the effect of being stamped in.

Rococo. An Italian lace, bearing the rococo design.

Rose Point. See Venetian point.

Seaming Lace. Narrow, openwork insertion.

Seville. A variety of torchon.

Spanish Lace. A comprehensive term. Convent-made needlepoint lace. Cut drawnwork effects, also convent-made. Needlepoint lace in large squares. Black silk lace in floral designs.

Spanish Point. An ancient embroidery of gold, silver, and silk passementerie.

Swiss Lace. Swiss embroidered net in imitation of Brussels.

Tambour. A variety of Limerick.

Tape Lace. A hand-made needle lace, similar to Renaissance.

Thread Lace. Made of linen thread, as distinguished from cotton and silk laces.

Torchon. A coarse, open bobbin lace of stout but loosely twisted thread in very simple patterns. Much seen in imitations, usually in narrow widths. In real torchon the thread used is usually of linen, while in the imitation, or machine-made torchon, cotton is usually used. Two sizes of thread are used in the machine-made, while in the real torchon only one thread is used; the threads in the machine-made are irregular and loose, while those in the real lace are straight and taut.

Van Dyke Points. Applied to lace with a border made in large points.

Valenciennes. *Val*, as it is usually called, is a very fine and attractive lace of flat design, that is, it has no raised work. The net is generally diamond-shaped. Machine val is similar to the real in appearance. The surface is rougher and the lace thickens when washed. Machine-made val is usually of cotton. The real lace remains smooth and fine after washing.

Venetian Point. Point de Venise. A needlepoint lace in floral

pattern with the designs very close together and connected by brides ornamented with picots.

Wood Fiber. Applied to all laces made of wood silk.

Yak. A machine-made worsted lace. It is used for trimming for shawls, petticoats, and undergarments.

Youghal. A needlepoint lace of coarse thread, made exclusively in Ireland.

Ypres. A bobbin lace, somewhat coarser than Val.

Lace Curtains. In making a fabric on a lace-curtain machine it is necessary to have at least three sets of yarn, instead of two sets as in the weaving of ordinary cloth on a loom. These three sets of yarn consist of a warp yarn, known as the main warp (or ground warp) yarn; a spool yarn, which takes the place of the filling on a plain loom; and the so-called brass-bobbin yarn, which acts as a binder between the warp and the spool yarns by spiraling around the warp. For producing special types of curtains there may be used an additional beam warp or an additional spool yarn. The extra beam yarn is used to get a variety of grounds, such as cross ground, madras, bar net, or fillet. Spool yarn is used for ornamentation, and when the ornamentation takes the form of a shaded effect by reason of two counts of yarn, or by a contrast in shade, an extra bank of spools is used, and the yarn is known in the trade as fine-spool yarn.

Brass-bobbin Yarns for Curtains. It should be noted that the brass bobbins used in the three types of lace machines (using "lace" in its general sense as including lace curtains, fancy laces, and bobbinet, each of which is made on a special type of machine) are entirely different from, and have no resemblance to, the ordinary wooden bobbins used on spinning machines; and that brass-bobbin yarn, sometimes known simply as bobbin yarn, represents a special type of yarn. Lace curtains are "made" on a beam at the top of the machine by intertwisting thousands of vertical warp and spool yarns with thousands of bobbin yarns carried in thin chariots which swing pendulum-like back and forth in an unbroken line, shifting at each swing one or more spaces or "gaits" to the right or left. The chariots are guided in their reciprocating courses by grooves, and each chariot holds, by means of a spring, a brass bobbin. These brass bobbins are made up of

thin rolled-brass disks, grooved on their inner edges, and riveted together. Each brass bobbin has a square central orifice which is used in sliding a number of them together on a square shaft where they are refilled with yarn. This square shaft is revolved, and an end of yarn is guided on to each circumferential groove. When filled with yarn the bobbins are taken off the square shaft and placed in the thin chariots or carriages, and these are then ready for use on the machine. Brass-bobbin yarns are imported in the skein, put up in 10-pound bundles, usually 50 bundles to a bale.

In order to get as many yards as possible on each brass bobbin, and thus cut down the number of stoppages for renewal of bobbins, the yarn is " prepared " by being passed in the hank through the rollers of a special " yarn-preparing machine." This calendering process flattens the yarn from a round to an oblate shape, renders it more flexible, and also polishes it in the process. In " preparing," the yarn is usually greased as well as calendered, as greasing makes it more supple and elastic and thus better able to withstand the hard treatment to which it is subjected on the machine. The lubricants usually employed are cocoanut oil, lard, or mutton fat.

The weight of the curtain, as it is being formed, hangs largely on the brass-bobbin yarn; this yarn must therefore be not only smooth and uniform but must be made of long staple cotton and spun and doubled carefully so as to have the strength to withstand the abnormal strain. The standard breaking weights for brass-bobbin yarns, using a strength tester which handles a lea of 120 yards, are greater than for ordinary yarns and are usually stated as follows:

Brass-bobbin yarns for curtains.

Counts	Standard breaking weights in pounds
58/2	108–112
68/2	105–108
78/2	95–100
98/2	85– 87

As previously stated, the " point " of the machine indicates the number of bobbins working in 1 inch of space. As they must run free, there is a count of brass-bobbin yarn for each machine which gives the best results, and those counts are uniform in the trade. Thus for the 6-point machine there is normally employed 58/2 brass-bobbin yarn, for the 8 and 10-point machines there is used 68/2, for the 12-point 78/2, for the 14-point and 16-point 98/2. The lace-curtain machine rarely uses yarns finer than 98/2. The length of yarn that can be wound on a brass bobbin varies according to the size of the bobbin and the count of the yarn, but is usually between 80 and 180 yards. For the most part, the more modern the machine the larger the bobbin, so as to reduce the percentage of stoppage for renewals and also the percentage of waste which is necessarily made whenever bobbins are replenished with yarn.

Brass-bobbin yarns are almost always required in the two ply. They are mainly of Egyptian cotton though sea island is used for the best quality.

Embroideries. Examine a piece of embroidery. Notice that it is made of ornamental stitching on a foundation of cloth or net.

The term *embroidery* is from Anglo-Saxon *broid, bord*, border, the edge or margin of anything; probably so called because at first embroidery work was chiefly used upon the edge or border of church vestments and ecclesiastical garments. It later came to mean the art of working with the needle ornamental designs upon silk, wool, cotton, or other woven material. The difference between loom-figured fabrics and embroidery lies in the mode and manner of producing the design. In the former, the ornamental pattern grows simultaneously with the texture in the loom; in embroidery, a woven fabric is required as a foundation, and

the free artistic hand works out the embellishment upon it.

The first embroidering machine was invented by Joseph Heilman, of Alsace, in 1828. Although in principle very much the same as the machine now in use, it was very crude and incomplete in construction, and it was not until 1840 that Rittmyer and Volger succeeded in perfecting the machine in use at present.

The first machine-made embroidery shipped to the United States was in 1853. The goods were consigned to a New York house by S. Hamel, of Hamburg, Germany, who is directly responsible for the adoption in this country of the name Hamburgs as a descriptive term for Swiss embroideries. It is said that he called them by this name in order to make the business world believe it was in Hamburg that the goods were manufactured.

In addition to white edging, insertion, flouncing, and allover embroidery, the Swiss machine produces a wide range of more expensive goods, such as collars, capes, chemisettes, handkerchiefs, lace, ladies' and children's underwear, trimming for garments and for millinery in yard goods. In the United States there are in operation about 500 Swiss embroidery machines. They are employed for the most part on silk and chiffon embroidery, fancy trimmings, robes, flannels, badges, etc. Some embroidery machines are operated by hand, but the majority are power driven. The latter are known as shuttle or *schiffli* machines.

The Schiffli Machine. The process on a schiffli machine is similar to that on a sewing machine, except

that instead of a single needle there is a row of needles, and instead of the cloth being laid horizontally, it is fastened vertically. The needles are fastened horizontally on a sliding bar, and each needle does the same work; the horizontal distance between them shows the repeat, usually called the *rapport* of the pattern. Each needle carries through its " embroidery " thread, and before this is withdrawn it is fastened in place with a lock stitch, similar to that of the ordinary sewing machine stitch, made with " schiffle " yarn carried by a small shuttle sliding in a groove back of the cloth. As the needles are moved in and out on a fixed slide, their working place in the cloth can be controlled only by moving the cloth. The foundation material is therefore mounted with pinhooks on a movable framework that can be shifted to right or left, or up and down, by means of a device for decreasing the size of design, called a *pantograph*. The pointer of the pantograph is held by the stitcher, who stands at the left of the frame and follows the lines of a design tacked on a vertical board. For convenience in tracing, the design is usually six times larger than the embroidery pattern being produced, and the pantograph is arranged for this proportion. In the operation of the more expensive " automatis," the stitcher is eliminated and the machine embroiders automatically according to the design punched on a Jacquard card. Practically all schiffli machines embroider two strips at once, one above the other, but every needle on the whole machine does the same kind of work.

The capacity of this machine is nearly eight times greater, (or from 15,000 to 18,000 stitches per day against 2000 to 3000) than the hand machine. To offset this advantage, however, the schiffli is much more expensive, and is of delicate and complicated construction, easily got out of order, and costly to repair. Until a comparatively recent date the schiffli was not considered as a competitor of the hand machine, its work being inferior in quality and confined to simple patterns.

It is the latter fact which accounts for the great advantage of the embroidering machine over the lace machine. The preparing and setting of a design for a lace machine is very expensive, and the great cost compels the manufacturer of machine lace to turn out large quantities of one set pattern in order to get a return from his investment. This disadvantage had enabled the embroidering machine to enter the field as a successful competitor for making laces. Up to 1881, embroideries were the almost exclusive product of the machine, for which various cottons, such as cambric, swiss, nainsook, and madapollam were used. But in the year above mentioned a German inventor of Plauen succeeded, after many attempts, in producing designs on tulle, or silk bobbinet, with the embroidering machine, thereby imitating hand-made lace. The first attempts at embroidering tulle consisted in making small, tasteful flower patterns, to which were later added patterns in relief. Then came the imitation of point gauze lace, guipures in cotton, and crêpe laces

(*lisse*) in silk, until many of the most popular tissues of the day were reproduced. These goods are now manufactured to a considerable extent in the United States, the patterns being executed in the most perfect manner by power machines.

Bonnaz Embroidery is a variety of so-called embroidery work produced by means of a Bonnaz machine. The machine itself, both in principle and appearance, is similar to the ordinary sewing machine, except that it produces a tambour, drop, or chain stitch. The needle, instead of being stationary, is movable, so that it can be made to follow around the outlines of complicated patterns, such as scrolls, circles, loops, vine work, and the like, without the necessity of moving the cloth that is being embroidered. This feature is of great advantage where rapidity of production is an object, particularly in the formation of involved patterns on large pieces of cloth, such as Brussels and tambour curtains, dress goods, and the like. Any size of thread that may be desired can be used, from fine silk to coarse cotton yarn or cord. The Bonnaz machine is especially employed for the production of ornamental stitching or appliqué work on lace curtains, white goods, hosiery, underwear, corsets, slippers, regalias, upholstery goods, etc.; also, for chain-stitch embroidery work in silk or worsted on robes, allovers, waists, dresses, cloaks, and suits. (See Art Embroidery.)

Silk Nets and Nettings. Netting is made by intertwisting fine threads to form open meshes, usually hexagonal in shape, without any ornamentation. *Net*, some-

times used as a synonym for netting, is correctly a particular length of netting, and in the silk industry usually has reference only to silk hair nets. The production of silk netting in the United States is very small, the demand being met by imports mainly from France. Nottingham makes a specialty of cotton nets. Some silk netting is imported as foundation for embroidery, but most of it is for direct use in making clothing. Silk nets are also mainly imported; these are generally made with elastic around the edges.

Hair Nets. Hair nets were made of fine silk as early as 1853. In order to obtain a more nearly invisible material than silk, women conceived the idea of utilizing human hair. Austria became a large center for making nets out of hair, until the World War, when the manufacture was transferred to China, where it is to-day a large industry performed in the home of the workers. Practically all of the hair nets used in the country are imported from China.

The human hair used is imported in the raw state from China, to be dyed here and then shipped back to that country to be fashioned. The hair is derived from the combings of the women, who are content to accept a few pennies for the amount they have saved for many months. The combings are gathered together at three collection points — Hongkong, Canton, and Hankow. The hair is then straightened, assorted in various lengths, and made ready for export to the United States and Europe. In this country the longer hair strands, ranging from 22 to 36 inches, are picked out and the American hair preparers bleach and dye the strands with powerful chemical agents. The various colors are thus produced for hair net making, namely, light, medium, and dark brown, blond, black, auburn, and white. The hair is further processed

through many chemical baths in order to render it perfectly sanitary. The finished hair is returned to North China and there distributed or sold to the natives for manufacture.

One of the notable things about the production of hair nets is that so far, even in this mechanical age, it has been found impossible to make them by machinery. Owing to the fine texture of human hair and the shortness of the strands, no machine has yet been invented that is able to knit the delicate nets. All of the fashioning must be done by hand, and 95 per cent of all the hair nets produced are knitted in the homes of Chinese natives.

The training required for the knitting of hair nets is long and tedious. The natives engaged in the occupation acquire their manual skill in their youth, when their fingers are supple and their sight is keen. The net hair is tied end to end, strand by strand, so as to form a long string. This is then wound around a long shuttle, which is worked around a polished bamboo stick or bodkin. This bodkin regulates the size of the mesh of the net. Each net is tied in much the same way as in the manufacture of fish nets or hammocks; but, of course, the tying of a single strand is a much more delicate and difficult task. The production of a dozen hair nets in ten or twelve hours is regarded as a good day's work. The finished products are then shipped back to this country and distributed through various channels.

There are two types of hair nets, — single mesh and double mesh. The single mesh is not so strong as the double mesh, but is less noticeable.

Net. A very open fabric made of silk, cotton, hemp, hair, or other fibers by knotting the threads or yarns at every point where they cross each other, thus forming meshes. Its character, weight, and composition show great variety, from the coarse and heavy fishing or hunting nets to the finest hair nets.

Maline. A fine, machine-made net having small hexagonal mesh and given a crisp finish. It is used

extensively as trimming in millinery. The name is derived from the Maline lace, the hexagonal mesh of which manufacturers have tried to imitate.

Silk Veils and Veilings. "Veilings" is a general commercial term which is applied to a great variety of specific articles, such as chiffon, grenadine, fancy netting, having fancy (veiling) meshes, or ornamented with a bar, or border, or figure, used chiefly or exclusively for the making of veils. A *veil* is a particular length of veiling, designed to be worn over the head or face as a protection or as an ornament, wholly or partly to conceal the face from view.

Braid. A narrow textile band or tape, formed by twisting together several strands of silk, cotton, wool, or other material, used as trimming or binding for garments, for stay laces, shoe laces, etc. The art of braiding in its most primitive form dates back to the dawn of civilization. It is as old as the art of weaving, and very likely preceded it. Twigs cut from trees of the forest entwined into mats, used as a protection against the elements, have been discovered among the remains of many prehistoric peoples, and in this operation is found the germ of braiding, spinning, and weaving.

The oldest known form of hand braiding is probably the braiding of a woman's hair, but, apart from this, the art of braiding by hand has without doubt been carried on by most savage tribes and peoples in all parts of the world.

A braid is formed by crossing diagonally and lengthwise several threads in such a way that each of them

lies alternately over and under one or several of the others. This means that at least three strands are required to form a braid; two could only be twisted around each other. The material used is of great variety, according to the purpose the braid is to serve. Straw, bast, wire, cane, etc., are used; in most cases, however, threads of cotton, worsted, mohair, silk, linen, jute, and tinsel are employed. Braidmakers seldom, if ever, make their own yarns, these being purchased of regular spinners, who make this a special business.

The braids manufactured at the present day may be divided into four classes, according to the manner in which the threads are united: (1) Flat braids; (2) tubular braids and cords; (3) stripe braids; (4) lace braids.

Flat braid consists of a number of threads laid in zigzag shape, and each thread crosses every one of the others, lying alternately over and under them. *Tubular braids* and *cords* are formed by uniting an even number of threads, one half of which run from right to left, the other half from left to right; the threads of the same group do not cross each other, but cross alternately over and under the threads of the opposing group. *Stripe* or *Alliance* braids are formed by joining together two or more flat braids in such a manner that the threads of the two are either joined together or twisted around each other. Each section can be of a different color or material from the rest. *Lace* braids consist of several braids running parallel with each other, in which two adjoining sections exchange threads at intervals, leav-

ing between these intervals holes which produce the lace effect.

The process of braiding is accomplished by means of power machines, which weigh from 100 to 600 pounds each. For each different width and variety of braid a separate machine is necessary. So nearly automatic is the action of the modern braiders that one girl can attend from two to eight machines without difficulty.

The distinctive difference between braiding and weaving lies in the fact that in braiding the threads of one series are crossed lengthwise, passing alternately over and under each other, making a texture composed of warp threads only; while in weaving, two series of threads cross each other at right angles. Of the two processes weaving is by far the more important, as in it there is almost no limit to the width and design of the fabric.

QUESTIONS

1. (*a*) What is lace? (*b*) How is it made? (*c*) How does it differ from a knitted fabric?
2. What is the difference between lace and embroidery?
3. Name the parts of a lace. What is the difference between hand-made lace and machine-made lace?
4. Describe the manufacture of needlepoint lace.
5. (*a*) Describe the manufacture of bobbin or pillow lace.
   (*b*) How does it differ from needlepoint lace?
6. Explain the manufacture of lace by machine.
7. Give briefly the history of lace.
8. Describe the selling points of filet lace?
9. (*a*) What is embroidery? (*b*) What are its selling points? Of Valenciennes lace? Of torchon lace?

10. Trace the artistic development of embroidery designs.

11. State the uses of embroidery.

12. What are the two chief classes of embroidery? Describe each.

13. Explain the mechanism of Bonnaz embroidery; of schiffli lace.

14. How are designs transmitted to the lace on machine embroidery?

15. (*a*) What is veiling? (*b*) How does it differ from lace and embroidery? (*c*) How is it made? (*d*) How is it described? (*e*) What are the selling points?

CHAPTER XXIII

CLASSIFICATION OF FABRICS

All fabrics may be classified as dress fabrics or as upholstery (decorative) fabrics. Dress fabrics include all materials used for clothing or for household service. Decorative fabrics such as curtains, carpets, etc., are those used for upholstery or decorative purposes.

Under dress fabrics we may include —

Suitings	Quilts
Overcoatings	Polishing Cloth
Trouserings	Mittens
Vestings	Corsets
Skirtings	Blankets
Shirtings	Cotton Batting
Handkerchiefs	Sheets
Mufflers	Linings
Collars and Cuffs	Shawls
Toweling	

Suiting. A suiting is a woolen or worsted fabric weighing from 8 to 16 ounces per yard. Men's suitings are expected to hold the shape given to the fabric when made into suits by the tailor. In order to do this, it is necessary for men's suitings to be composed of two-ply yarn with a fair amount of twist to give the desired

stiffness. Women's suitings, on the other hand, are expected to be softer so as to " drape well " on the figure. Therefore the fabric is made of single-ply yarn with softer twist. Sometimes the fabric is a union composed of a cotton warp and a worsted or woolen filling.

Among the principal classes are the following:

1. Tennis suitings, composed of all wool, or all worsted, white or cream ground, decorated with solid color, silk and weave stripe effects.

2. Piece-dyed worsteds, such as a blue ground with white silk line, cable cord, and fancy weave stripe effects, or any other ground shade color with its complementary decoration applied.

3. Mixture wool or mixture worsted yarns made into fabrics, decorations applied in color; cable, silk, and weave effects in stripes or overline color checks, suitable for men's wear, or decorated suitable for woman's wear. The darker shades are for fall and the lighter shades for spring.

General weight of fabric for men's wear, 12 to 14 oz. per yd., 56 in.; general weight of fabric for ladies' wear, 8 to 12 oz. per yd., 54 in.

4. As a rule, when one speaks of a suiting, one expects to see a fancy effect, in the form of a fancy stripe, check, or a colored mixture, in loud or quiet tones of decoration. Long naps in fancy effects are sometimes fashionable, and at other times the cloth finish is popular. This class may be subdivided into

1. Light weight for spring or fall.
2. Heavy weight for winter.

The light-weight class generally consists of covert cloths in lighter colors for spring, and cloths, usually of the undressed finish, from worsted or woolen stock for fall.

The heavy weight class generally consists of heavily fulled goods, such as meltons, beavers, naps, etc., which give a heavier and warmer coat for winter use; where an exceptionally heavy coat is required, double and treble cloths are occasionally employed.

Examine different kinds of suitings and classify them.

Overcoatings. Overcoatings are heavy woolen or worsted fabrics, heavily teaseled or gigged, having a rough, hairy appearance. Whether thick or thin, coarse or fine, they should always be elastic fabrics, that is, as much so as well fulled woolen goods can be. When hard or stiff they never make a graceful garment. The special goods made for overcoats are nearly all soft goods.

Examine different fabrics and classify them into either suitings, overcoatings, trouserings, etc.

Trouserings. Trouserings are more firmly woven than suitings and are heavier. They invariably have a stripe. The ground shade of the better grade of men's wear fabrics is generally composed of twist warp yarns, ranging from dark slate gray to light lavender gray. An endless variety of broad and narrow fine line effects is produced by expert manipulation and combination of weave and silk decorations, giving the pleasing effect required for this class of goods. The filling is nearly always black; but sometimes a dark slate is used. The cheaper grades are generally made of wool

and cotton mixtures and twists, down to all cotton, in imitation of the better grades.

Vesting is a term covering a large variety of fabrics used both for fancy vests and for dress purposes. It includes principally piqués and Bedford cords, with various types of similar weaves. Vestings are usually medium and heavy weight cloths which present a series of heavy welts or figures evenly distributed over the surface. At one time used extensively for men's vests, their largest present use is probably for ladies' skirting and ladies' and children's suitings. Lighter grades are also used as shirting, blouse material, stocks, and other neckwear, and have recently come into extensive use for soft collars in plain and fancy welts. The heavy grades are used for quilting and for uniforms and riding trousers. The various types of vesting are largely produced in plain white, but may also be printed. When intended for vesting they are often finished cream-white and mercerized. The typical piqué vesting presents a surface of lateral or filling lines or welts across the width of the cloth, with fine sunken lines between. The width of the welts varies from one twentieth to one fourth of an inch. The typical Bedford cord vesting presents the identical appearance except that the welts are longitudinal or warpwise. Other types of vestings usually have figured effects raised on the surface of the cloth, and may be variations or combinations of the piqué and Bedford cord weaves or of some similar special weave.

In the past, when white vests were in general use for men, all types of vesting were used. As these are no

longer in general use except for evening wear, it is probable that the consumption has decreased rather than increased, though the decline has been offset to some extent by the increasing use of soft collars. Domestic mills confine their operations to the staple and simple novelty patterns, supplying the bulk of the domestic demand for these. These cloths, even in the simplest weave, are rather difficult and costly to produce; there is not sufficient demand to justify the expense and hazard of producing special patterns.

Shirtings. Cotton shirting is a light-weight, washable cotton cloth, woven almost exclusively in 32-inch width. When colored yarn is used it is stock or yarn dyed. The weave may be plain, or the fabric may be decorated by the use of special weaves in conjunction with the plain. Some of the basic weaves used, such as the matting or the poplin weave, are simple derivatives of the plain weave. The various shirting materials find their largest use for men's shirts, but may occasionally be used for women's dresses and waists.

The plain woven, plain and corded gingham shirtings make up a large part of the consumption of medium and high grade, color-woven, cotton shirting. The bulk of the " fine shirting," however, is termed *madras*. The name " madras shirting " is often made to include the plain woven, plain and corded, gingham shirting, but madras is in reality one step beyond these. It is made with a white ground in plain weave, with narrow dobby woven sateen stripes of dyed or mercerized yarns in one or more colors. These stripes often take

the form of cords and are sometimes made of silk or artificial silk. Other types of shirting which may be classed with madras are the bleached and colored Jacquard and dobby shirtings. These may be figured all over with small Jacquard or dobby designs or in narrow Jacquard figures stripes. In all cases of the latter they are more often produced in two colors, one color forming mosaic figures on the stripe, of which the other color forms the background. One of the most costly corded effects, often classed with madras, is the *Russian cord.* The surface threads of this cord are usually of mercerized, fine ply yarn. Though the cords run with the warp or length of the cloth, the threads which form the surface work back and forth across the cord surface. Many heavily corded ginghams are represented as Russian cords, but these are made by bunching a number of warp threads in the warp to form the cord.

Derivatives of the plain weave, which are often used in weaving shirting, are the hopsack or matting weave, commonly known as the basket weave, and warp or filling rib weaves. The basket-woven shirting is usually known as *Oxford* shirting. It is constructed by weaving two or more warp and filling threads in unison. This gives much the same appearance as if narrow tapes had been woven together in plain weave. The warp and filling show equally on both sides of the cloth in small squares or rectangles. Oxford shirting may be plain all-over basket weave or may be in combination with other weaves and colored threads. Poplin, a plain woven fabric with transverse or filling ribs, is

used to some extent for shirting. Shirting poplin is mercerized and may be bleached or woven in warp stripes; the best grades are an excellent substitute for silk shirting.

Shirting is ornamented in weaving by various combinations of all these methods, as plain woven cords or stripes in combination with Jacquard or dobby woven stripes and figures, or colored Russian cords. Mercerization of the decorative yarn or of the entire fabric is often used to give a lustrous finish. The method of decorating by fancy weaves, especially in the case of those requiring the Jacquard or leno attachment, materially reduces the speed of the loom, making production slow and costly. The bulk of the imports are of fine quality, woven of yarn mule-spun from high-grade cotton. Ring-spun yarn is often used in the decorations to make the pattern more clear cut. As in the case of gingham, foreign manufacturers will produce in smaller quantities of a pattern and color and will also give exclusive rights to a pattern. This makes the imported shirting especially attractive to the custom shirt makers, who cater to a class of exclusive dressers who are willing to pay extra to have their shirts fit well and to obtain new and exclusive patterns. Reasonable additions to the cost because of tariff or other charges has little effect on this special trade, which in the large centers is supplied largely by imports.

The word *shirt* is derived from Anglo-Saxon *scorte*, short; literally " short garment." It was called by our early Saxon ancestors indiscriminately *sherte* or *camise*

(chemise), and the undergarments of both sexes were then of similar shape and materials. The words shirt and skirt have a common origin. The name "shirt" is now given to a garment worn only by men and a similar garment worn by infants. In the United States, the shirt ordinarily worn by men is of cotton. Formerly, linen was the popular material for the body of shirts as well as for the parts intended to be starched, but since about 1840 cotton has usurped its place except in the case of white shirts, in the making of which linen continues to be used for the exposed portions. Within the past decade the long-used white shirt made with a cotton body and linen front has been largely displaced by the colored shirt, made both in the dress and negligée styles. Colored shirts first caught the popular fancy in 1892, since which time they have been very generally worn in the United States by men of all classes. One result of the popularity of this style of garment has been to increase greatly the number of shirting materials; whereas, in 1890 percale and cheviot represented the principal fabrics employed in the manufacture of the better grades of colored shirts, the number of different materials now used runs into scores. There has also been a constant effort on the part of designers to improve upon the patterns of shirtings, until at present the ornamentation of this class of goods receives the same attention that is bestowed upon far more expensive textiles.

In shirt numbering one-half inch in the length of the neckband constitutes a "size." With this is associated

the length of the sleeve. Manufacturers of stock shirts make six different lengths of sleeves.

Of stock shirts there are four principal varieties, known respectively as working shirts, negligée shirts, dress shirts, and full dress shirts. The *working shirt* is a variety designed especially for rough wear, made usually open in front and with collar attached. A large variety of stout washable cotton and woolen fabrics are utilized in the manufacture of this class of shirts, as cheviot, denim, percale, calico, sateen, osnaburg, moleskin, flannel, domet or outing cloth, etc. The *negligée shirt* is a soft, unstarched, semi-dress variety, made usually open in front and either with or without collar and with soft cuffs. The materials employed for negligée shirts are of the most diverse character, many fabrics of a fanciful or ornamental weave being manufactured especially for the general use of this class of goods. One form of negligée shirt is called a shirt-waist. It is essentially a summer garment, and is designed to be worn only in extremely hot weather when the coat and vest become burdensome. Although fashioned in various styles, the more common form is made about 23 inches in length. It is cut with a yoke, and ornamented back and front with one or more box pleats. A drawstring at the waist line provides for proper adjustment at that point. Like many negligée shirts, the *shirt-waist* is finished with a pocket and attached cuffs, but without a collar. When of the latter style the suspenders are worn underneath, the garment being provided with openings for the suspender ends. As thus worn the

waist assumes a blouse form and folds loosely over the waistband of the trousers.

Dress shirt is the name at present commonly applied to a laundered white or colored shirt, made with a set-in front, whether of the same material as the body or different from it. *Full dress* is the name given to white shirts of fine quality made with extra wide bosoms.

Mitten. A mitten is a covering for the hand, with one sheath for the thumb and another for the other four fingers. A glove differs from a mitten by having a separate sheath for each finger. Gloves and mittens are of three types, according to the method of manufacture:

(1) Seamless, — knit continuously so that no seams are required in finishing.

(2) Fashioned or wrought, — knit flat to shape with selvedged edges which are afterwards sewn together.

(3) Cut, — made from knitted fabric without any shape being given in the knitting.

Mittens as a rule are seamless; gloves are of all three types.

Wool gloves are worn principally for warmth, but for sports wear are developed in attractive designs which change from season to season. Fleece-lined cotton gloves and possibly cheap grades of kid gloves offer some competition to the wool knit-glove industry. Wool, worsted, and merino yarn, described in the discussion on wool hosiery, are used in the manufacture of gloves and mittens.

In the manufacture of gloves or mittens cut and

sewed to shape, ordinary circular or flat machines are used for making the cloth, from which they are cut by dies. For the manufacture of gloves from a continuous yarn no automatic machinery is available.

A glove has three main parts, viz: (1) the cuff or top, (2) the hand, (3) the fingers and thumb. *Seamless* gloves are produced quickly in large numbers by making the rib top and plain hand automatically on a circular rib machine of the superimposed cylinder type, but the fingering has to be effected one finger at a time on hand flat-knitting machines, and is a very slow process. *Wrought* gloves have all the parts made selvedged to shape on straight bar-bearded needle machines, the selvedged edges being finally seamed on a cup seaming machine.

Mufflers. Originally, a sort of kerchief or scarf worn by women to cover the lower part of the face, the neck, ears, etc., either for protection against the sun or wind, or for partial concealment when in public. At present the name is applied to an ornamental wrapper or scarf of wool, silk, or fur worn by men in winter as a protection for the throat. The modern muffler is made in two general forms, either as a padded and quilted scarf from 4 to 6 inches in width (commonly known as the Harvard), or as a large-square kerchief. When of the latter form, it is intended to be folded diagonally a number of times so that it may be made to encircle the neck conveniently.

Handkerchiefs. Handkerchiefs are made in a great variety of styles, from plain hemmed cotton and linen

to fine silk and lace. Ordinary handkerchiefs are woven on a loom, two or more in a breadth, and then cut apart and finished. Loom-made handkerchiefs include such types as the hemstitched; those woven with corded, ribbed, or crammed borders; and those woven-figured by means of the dobby or Jacquard. Some handkerchiefs are further finished and ornamented by printing, by embroidering with an initial letter or monogram, or by trimming with lace. Reversed handkerchiefs are those ornamented by drawnwork made by pulling out certain threads and grouping those in the openwork portion to give an ornamental effect.

All grades of light-weight cotton cloth from 20's to 42's, longcloth from 40's to 60's, ordinary print cloth up to the finest combed lawn, 60's to 110's or finer, are used for making handkerchiefs. These are of varied styles and sizes; women's handkerchiefs are made up to 15 inches square, whereas men's handkerchiefs are mainly 18 to 23 inches square. Mufflers may be considered large kerchiefs.

Methods of production. The handkerchief manufacturers buy their cloth, which is therefore the " raw material " of the handkerchief industry. After being bleached, and in some cases dyed or printed, the cloth is cut and the edges are hemmed or hemstitched on machines. The handkerchiefs are then ironed, folded, boxed, and cased. Handkerchiefs may be woven as such on the loom, but this method is not in general use in the United States.

The processes are so simple that no special machinery

is required; the hemming is done on ordinary power sewing machines, and a relatively simple machine with special attachment will hemstitch at about the speed of regular hemming. Hand hemstitching is a very much slower operation, hence much more costly. For this reason hand hemstitched handkerchiefs are usually imported. For hand hemstitching, threads must be drawn along the line where the hem is turned; this is also done in the better grades of machine work to make it more nearly resemble the hand hemstitching. In the cheaper grades no threads are drawn; each stitch of the coarse needles punctures the fabric, giving a line of perforations which simulate drawn threads. These machines are not difficult to operate and may easily be run by semi-skilled labor. The operatives are usually women or girls. Quantities of plain hemmed and machine hemstitched handkerchiefs are among those imported from all countries, and probably the work has been done on American-made machines, which have a wide market in all parts of the world.

The importation of fancy silk handkerchiefs is small. The bulk of the imports consists of ordinary hemstitched handkerchiefs, followed by those cut, not hemmed or only hemmed. Most of the silk handkerchiefs imported into the United States come from Japan and are made of habutae.

Blankets. Blankets are napped fabrics, the nap being produced by a partial cutting and raising of the fibers. The processes have been so developed that a fabric entirely of cotton may be made to resemble wool,

or given what is known as a "wool finish." The springy feel of wool is sometimes obtained by a partial use of Chinese cotton, which is coarser and more crinkly than American cotton. Three distinct types of cotton blankets are commonly produced: staple blankets, which are plain woven with colored borders; wool-finish blankets, having colored borders; and Jacquard figured blankets. The staple blankets are much cheaper than those of wool finish or the Jacquard figured. The principal operations in blanket manufacture consist of weaving, napping, cutting, and binding or finishing with an overedge stitch. The common larger sizes are 64 by 78 inches and 72 by 84 inches, while the crib sizes are 30 by 40 inches and 36 by 50 inches. Warp yarns used in blanket manufacture are usually between 15's to 20's and the filling yarns 2's to 6's; these are of domestic production and carded only. The looms used in weaving are of domestic manufacture. In the finished blanket the warp ends are usually from 38 to 50 per inch, while the filling picks vary from 26 to 48 per inch. Other cloths are usually made in conjunction with the manufacture of blankets, some of which may be napped goods, outing flannels, felts, shirtings, shoe twills, etc.

Sheetings. Sheets are made from wide sheetings, which are plain woven cotton cloths varying in width from 36 to 90 inches; even greater widths are sometimes used. The cloth is bleached white, given a soft finish, then cut into suitable lengths and hemmed for use as bed sheets or sewed up for pillowcases. The 81-inch

width probably predominates for sheets, and 45 inches for pillowcases.

Pillow tubing is woven on a loom, and differs from ordinary cloth in that it is woven as two cloths, one above the other, forming a continuous tube. This tubing is bleached, cut into required lengths, sewed up at one end, while the other or open end is hemmed. It is then ready for use as pillowcases or bolster covers. The tubing widths, as woven, vary from 18 to 24 inches, the largest consumption being 42 and 45 inches in circumference. In practically all sheets and pillowcases the yarn is carded only, the warp being made of about 21's, and the filling from 25's to 30's; normal constructions are 64 by 64 to 72 by 72 ends per square inch. The cloth widths are usually from 36 to 90 inches, while the weights range from 3.50 to 1.30 yards, respectively, per pound. The most usual size for a sheet is 81 inches wide and 90 inches long; other sizes are 81 by 99, 72 by 90, 63 by 90, 90 by 99, and 90 by 108.

Lining. The fabrics used for lining garments are so numerous as almost to defy enumeration, and are characterized by the greatest diversity with respect to quality, weave, and materials entering into their construction. For lining men's garments the principal fabrics employed are Italian cloth, farmers' satin, serge, silesia, and various kinds of light silks, venetians, and satins. For lining women's dress skirts and bodices the materials in most common use for many years were silesia, cambric, drilling, percaline, mercerized sateen, taffeta, and velour, together with various mercerized and silk-striped

tissues sold under proprietary names; while for the interlining and stiffening of different parts of a dress there were used canvas, moreen, crinoline, wigan, buckram, haircloth, cotton flannel, etc. A lining is expected to be able to resist friction and have an attractive luster.

Quilts. Quilts, also termed bedspreads, coverlets, and counterpanes, are used as bed covering. There are two main types, one having two sets each of warp and of filling yarns; the other having one set of warp and one set of filling yarns.

Marseilles quilts are made with large embossed designs, one of which is complete on each quilt. The cloth is double; that is, composed of two plain woven fabrics which are not united at the ground but are interwoven at the figures, thereby producing the raised effect which is accentuated by the use of heavy filling as wadding. If the ground is of sufficient area, the two fabrics of which it is formed may be distinguished by rubbing the plain area between the fingers. The term "satin" when applied to cotton quilts refers to the structure, although it is not what is technically known as satin weave. It is also a double cloth, not in the sense that any part is made up of two distinct fabrics, but in that two sets of warp and two sets of filling yarns are used in its construction. A coarse filling floats over the ground yarns to form the pattern, and under the yarns when no pattern is required, making possible a reversible cloth if the design be planned with this end in view. When the ground is visible on one side, the heavy filling yarn will be visible on the other.

Crochet quilts have nothing in common with the ordinary work made with crochet needles. The term is given to a twilled or Jacquard single fabric, woven with one set of warp and one set of filling of medium or fine count yarns. The cheaper grades of quilts are usually of this structure. Honeycomb and Alhambra quilts are of the same class, differing principally in the type of design used.

Dimity spreads are made from plain woven fabrics having raised threads or cords running with the warp. These are cheaper than the quilts described above because they are simpler to weave. The material is woven continuously like any similar broad-loom fabric and then cut to size and hemmed.

Ripplettes. Bedspreads or bed coverings are sometimes made of "ripple cloth," a very servicable fabric, instead of cotton quilts, though their use is the same. These bedspreads are called *Ripplettes*, and are a variety of dimity spread made of thin cloth of sheeting texture having either cords or seersucker effect. It is not made on the Jacquard quilt loom, but on a common loom having two beams with different tensions; the beam with a looser tension feeds the yarn to the loom faster than does the other beam, and in this way causes a ripple effect in the woven cloth. The demand for this class of goods is chiefly from hospitals, where their cheapness and the ease with which they may be laundered make them particularly desirable.

Comfortables. These are sometimes spoken of in the

trade as quilts or comforts. They are made with two layers of fabric, between which is wadding or batting. The fabrics used are standard weaves of cloth having 32 to 36 warp threads per inch, and from 64 to 88 filling threads per inch; also sateen cloths with 64 to 104 threads per inch in the warp and 96 to 180 threads per inch in the filling. It is estimated that the domestic production of comfortables in 1920 was about 2,500,000.

Quilts vary in size from 92 to 108 inches for the larger ones, down to 28 by 63 inches for the crib size.

Cotton Batting. Batting is cotton fiber in thick but lightly matted sheets. The largest quantities are probably consumed in the manufacture of comforts and mattresses, but there are many other important uses. Tailors often pad coats with batting, and less frequently use it as a quilted interlining in overcoats; for these purposes it is dyed black. When a layer of batting is quilted between sheets of a thin fabric, such as China silk, it makes an admirably warm yet light material for coverlets and dressing gowns. Jewelers use considerable quantities of batting, either white or tinted, for packing their goods. A high-class batting with long fibers and little nap is preferred by this trade. By the removal of the natural wax which covers the cotton fiber, batting may be rendered absorbent. Large quantities are used for sanitary towels and surgical dressings. The bulk of the cotton batting is used for stuffing and is made from low grade soft cotton waste. Finer qualities of waste or raw cotton are made into better grades. Batting material, after being opened

and cleaned, is put through a card which has a special lap-forming attachment for superimposing the thin carded web to form any desired thickness. When wadding is required for special purposes, a gumming roller is employed to supply the gum or sizing; in this way the webs are made to adhere to each other. Most batting, whether gummed or ungummed, is sold without further processing. Some batting is bleached, dyed, or processed to make it absorbent, aseptic, or antiseptic. Medicated battings and battings impregnated with substances effective in cleaning and polishing are sold under proprietary and patented names and have gained a regular trade through advertising.

Toweling. Toweling is a fabric made of either cotton or linen and used for removing water from the body after washing. It should possess the following qualities:

1. Power to absorb moisture, or drying qualities. Linen is better than cotton.

2. It must be durable and reasonable in price. Good linen is more durable than cotton, but it costs more.

3. It may possess a soft or rough feel, according to the use. Face and hand towels are expected to be soft. Bath towels are expected to be a little harder in order to produce friction and increase circulation of blood.

4. It should have good laundering quality.

Cotton towels may be divided into two general classes: (1) Pile fabrics, mainly terry woven goods, which are familiarly known as Turkish or bath towels; and (2)

non-pile fabrics, mainly the ordinary huck or huckaback towels.

Terry cloth, from which Turkish towels are made, is woven with one filling and two sets of warp. The pile may cover the entire cloth, but usually it is woven with plain stripes at the head ends, where the towels are to be cut and hemmed, and frequently with a border of plain stripes or Jacquard figures. Bath mats and washcloths are also made of terry cloth. Any of these articles may be made as pile fabrics on knitting machines, but as yet this has not been done very extensively.

The term huck or huckaback towels applies to fabrics woven in patterns such as bird's-eye or honeycomb, which have yarn floats of soft, heavy filling to increase the absorptivity of the cloth. Harder twisted two-ply yarns are usually employed in the selvedge. Union huck towels are made of cotton and linen.

Toweling is sold by the piece, by the yard, or by the towel. The finished towel is usually hemmed or hemstitched, with a white or colored border. The cotton used in making towels is usually of low and medium grades, spun into comparatively coarse yarns; for terry cloth the warps are generally 20/2 to 30/2 yarn, and the filling 20's to 30's. Yarns for huck toweling vary considerably; the body yarns are usually singles, while the selvedge ends are two ply. The latter yarns are given as little twist as is consistent with good weaving. Turkish toweling is made on a loom having two warp beams and a special attachment for the terry motion; a Jac-

quard loom with a similar attachment is used for patterned material. A dobby loom with one warp beam and one shuttle is used for plain white huckaback towels; colored borders require a greater number of shuttles and a somewhat more complicated mechanism.

Polishing Cloths. These are small squares of napped cotton fabric, either 12 by 12 inches, or 18 by 18 inches, used in the household for polishing and dusting metal, glass, and wood; also in the harness trade and by the automobile accessory business. Prior to 1914 these cloths were made with striped borders woven on four sides, but to-day the greatest demand is for cloths with colored borders, and hemmed only on two opposite sides. These cloths are generally made of medium and heavy weight flannels; velveteen is also used in smaller quantity for polishing silverware.

Dust Cloths are usually 19 by 20 inches and have a border on all four sides. In general, the border yarns are red and blue; the body fabric has white yarns in one direction, and orange-colored yarns in the other, giving the cloth a light orange appearance. These are made of light flannel and not produced in the United States.

Mop Cloths, sometimes called scrub cloths, are usually all cotton, and are about 20 by 20 inches in size. The warp yarns are very coarse, with little twist; the filling yarns are almost one-eighth inch in diameter, and would be considered nearer a roving than a yarn. The squares are, in general, hemmed only on the two sides running parallel with the filling.

Wash Rags or cloths, also called face cloths, are about 15 by 15 inches and made of terry woven cloth. The borders usually contain colored yarns; many cloths have colored yarns running in both the warp and filling directions, and woven in such a manner as to form squares throughout, and others are made with plain white yarns.

Corset. This is an inner article of dress, usually stiffened by strips of steel or whalebone, to support the body or modify its shape. Almost all corsets have at least a finish of narrow lace. The main material used is coutil, often called corset cloth. It is a strong, heavy, closely woven cloth, made of medium coarse yarns. The weave is usually a five-harness warp sateen. Other materials used are wool cloth, elastic fabric, thread, metal clasps, or hooks, together with flexible steel, called ribs or bones, and laces. Formerly strips of whalebone, because of their strength and elasticity, were employed to give stiffness to corsets, but the scarcity and high price of this material has almost precluded its use.

Collars and Cuffs. Men's collars are manufactured in a wide variety of sizes and shapes and can in the main be divided into two classes, namely, the soft or unstarched, and the stiff or starched. Soft or unstarched collars have only recently come into general use; they are made in the form of a soft folded collar or military stock. Stiff collars are usually either folded, standing, or wing collars. When the industry first started, linen was the chief material, but cotton collars, starched

and unstarched, most of which are for men, now constitute the great bulk of the trade. A number of different cotton cloths are used in the manufacture of collars and cuffs. In the stiff or starched article the cloths used are rarely other than plain woven fabrics which are woven in the grey and afterwards bleached. Those used in the interlinings, which give body to the collar and serve as a holder for the starch, are coarse, heavy sheetings. The inner surface of the collar, the portion which comes in contact with the neck of the wearer, is composed of medium weight cloths, usually printcloths, while the exposed outer surface of the collar is composed of somewhat finer cloths, such as longcloths or nainsooks.

QUESTIONS

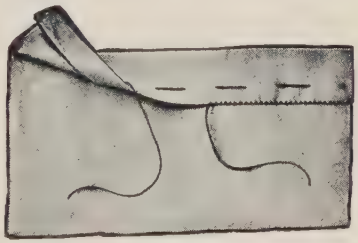
1. Why is the use of a fabric a very important point to consider in making it?
2. What are the different methods of describing a fabric?
3. (*a*) What is a suiting?
   (*b*) State some of the specifications.
   (*c*) Classify suitings.
4. What is an overcoating?
5. (*a*) Define a trousering.
   (*b*) What causes a trousering to be stiffer and hold the crease better than a suiting?
6. (*a*) Define a skirting.
   (*b*) How does it differ from a suiting?
7. (*a*) What is a shirting?
   (*b*) What kind of dyestuff can be used in shirtings?
   (*c*) What is a "fine shirting"?
   (*d*) How are stripes and designs produced?

8. (*a*) What is a mitten? How does it differ from a glove?
   (*b*) Describe the three types of mittens.
9. (*a*) Distinguish between a handkerchief and a muffler.
   (*b*) Describe the making of a handkerchief.
   (*c*) If silk, what kind of silk is used to make it?
10. Describe the methods of decorating these fabrics.
11. (*a*) What is a blanket? How are blankets made?
   (*b*) Name and describe the three types.
   (*c*) What kind of yarn is used?
12. (*a*) What is a sheet? How are sheets made?
   (*b*) What is pillow tubing?
13. (*a*) What is a lining?
   (*b*) Name the different linings.
   (*c*) State the requirements of a lining.
14. (*a*) What is a quilt?
   (*b*) Tell of the different types.
   (*c*) Compare: Marseilles, crochet, dimity, ripplettes, and comfortables.
15. (*a*) What is cotton batting?
   (*b*) Tell of its use.
   (*c*) How is it made?
16. (*a*) What is toweling?
   (*b*) State the uses and characteristics of a towel.
17. Name the different kinds of towels and describe each.
18. (*a*) What are polishing cloths?
   (*b*) Describe the different kinds and tell how each one is made.
19. (*a*) What is coutil?
   (*b*) How is it made and how does it differ from a drill?

CHAPTER XXIV

STITCHES AND ORNAMENTATION

Torn Cloth. When cloth is torn or cut, there are usually loose threads projecting from the cut portion of the warp or filling, and this makes the cloth unattractive. The cut or torn edge is called the raw edge of cloth. In order to make the edge attractive, it is folded over very evenly from one eighth to a quarter of an inch. This portion of the cloth that is folded is called a *hem*. The junction of the two pieces of cloth held together by sewing is called a *seam*.



HEM

Weaving and Stitching. In order to hold the hem in place, a form of weaving called *sewing* is used, in which a very strong yarn, called *thread*, is interlaced at intervals with the hem and the cloth. The interlacing is very much like the plain weave, the thread being pushed down or through a portion of the hem and cloth and then pulled up or through another portion, forming a curved line over the single and double cloth of the hem thus holding the cloth and hem together. Each complete interlacing of thread is called a *stitch*. In fact, sewing is

the principal method adopted for connecting or holding pieces of cloth together. In some cases, sewing may be used for decorative purposes. The stitches may be of temporary or permanent use in a fabric. To illustrate, if two pieces of cloth are to be joined together while going through a process like bleaching, the threads are expected to be of a temporary character. This method of sewing is called *basting* and may be *long*, *short*, or *uneven*, according to the length of the basting stitches. As we have different types of weaving, so we have different types of stitches, each for a particular use.

Reinforcements. In order to make a fabric ready for use, it is necessary to reinforce the edges so that the loose warp and filling threads will not appear. Various reinforcements are used, and in order to describe the selling points of a fabric, it is necessary to know the different types of stitches and edgings.

Types of Stitches. The principal types of stitches are as follows: Basting, running stitch, gathering, overhanding, feather stitching, overcasting, buttonhole stitching, blanket stitching, hemstitching, cross stitching, back stitching, slant hemming, blind hemming, slip stitching, etc.

1. *Basting stitches* are to hold pieces of cloth together for a temporary purpose.

2. *Running stitches* are very small stitches used to hold very firmly two or more pieces of cloth, and are expected to be permanent.

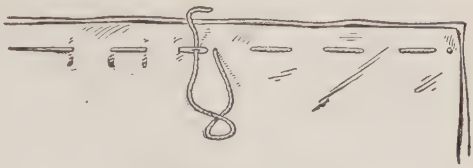
3. *Overhanding* stitches are tiny slanting stitches taken over the edges of folded cloth, such as are used in pocket making. The slanting stitching gives a decorative effect.

4. *Overcasting stitches* are used to keep the edges of a fabric from raveling. This form of stitching is similar to overhanding except that the stitches are deeper and farther apart, and the work is done from left to right.

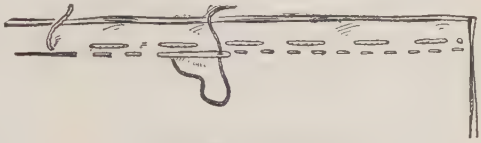
5. *Back stitching* is composed of a short stitch back on the upper side, and a longer one forward on the under side of the material. This stitch is used to secure strength and firmness.

6. *Cross stitching* is used for decorative purposes and is made by crossing two slanting stitches in the shape of the design.

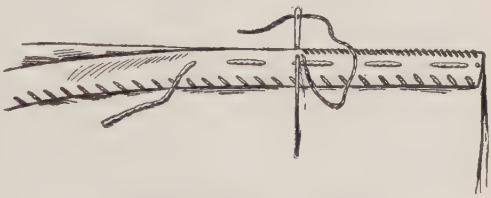
7. *Gathering* is a running stitch made so that the thread holds the cloth in such a way as to make it appear full. This is done by pulling the thread of the running stitches.



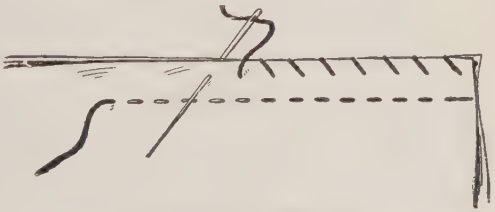
BASTING STITCHES



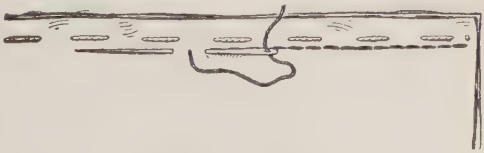
RUNNING STITCHES



OVERHANDING STITCHES



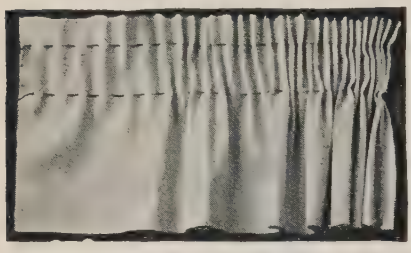
OVERCASTING STITCHES



BACK STITCHING

8. *Slant hemming stitches* are used for hems, facings, fells, etc. Each stitch slants on both the right and wrong side.

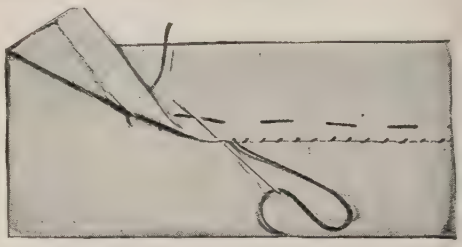
9. *Straight hemming stitch.* This stitch is similar to the slant stitch, only it is straight. It is used where an edge is to be held close with stitches that should show as little as possible, and is used preferably by tailors.



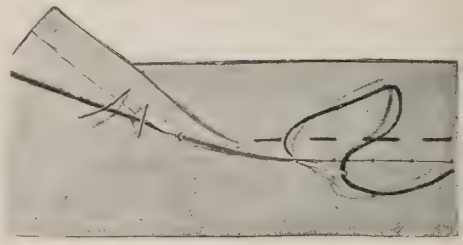
GATHERING

10. *Blind hemming.* This stitch is used where an invisible sewing is required to hold hems or facings on silk or wool. It is done more quickly than slip stitching and is just as invisible on the right side of the garment. It is not a strong stitch.

11. *Slip stitching.* This is used where invisible sewing is required for holding hems, facings, trimmings, etc. It is not a strong sewing, but it is one of the most valuable stitches for finishing work in silk or wool. In this stitch it is necessary to take only part of the thread in the material. This is what makes it invisible on the right side.



SLANT HEMMING STITCHES



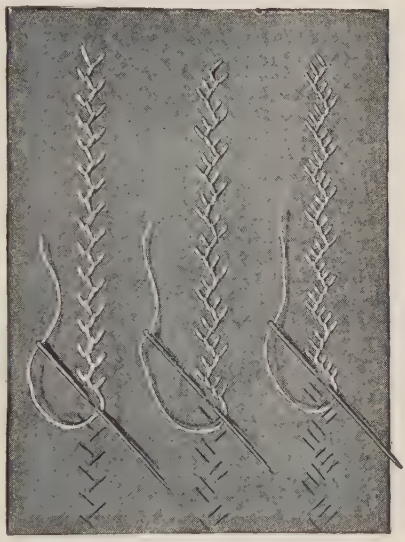
SLIP STITCHING

12. *Feather stitching* is used for decorating an article like an apron. It combines the holding process of the running stitch and also gives an added effect.

13. *Buttonhole stitches* are used to reinforce an opening for a buttonhole.

14. *Blanket stitch.* This stitch is used as a trimming on blouses

and dresses, and also to protect the edges of heavy woolen materials and to prevent them from "loosening" — fraying.

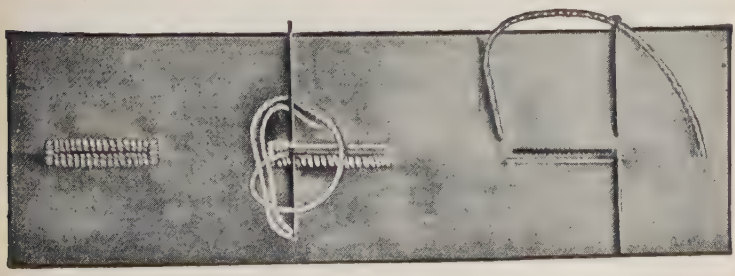


FEATHER STITCHING

While the above are the principal stitches there are many other stitches used in embroidery.

A *plain seam* is usually used in joining pieces of cloth for dresses and aprons and consists of joining two raw edges with a row of stitching. This stitching is carried a definite distance from the edge of the cloth.

A *French seam* is used for underwear, lingerie, and waists, and is so folded that the raw edge is covered.

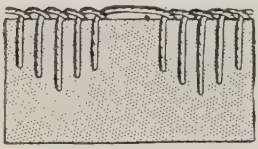


BUTTONHOLE STITCHES

Sewing or stitching may be done by hand or machine. Hand sewing is more expensive, and while it is not

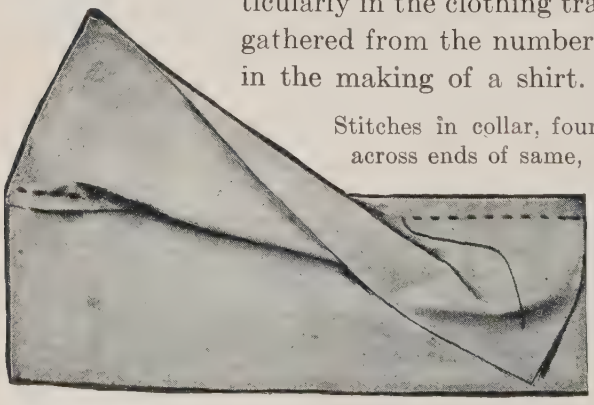
as even, it is done more carefully than machine sewing.

There are two types of machines for sewing: (1) The double thread or lock stitch machine, which is the common sewing machine using two threads, and is valuable because it gives the same stitching on both sides; and (2) the single thread or chain stitch machine, which uses one thread and can be used only in sewing on the right side of the cloth. Since only one thread is used, the thread must be fastened carefully, as the stitching pulls out easily.



BLANKET STITCH

Some idea of the importance of the stitching, particularly in the clothing trade, may be gathered from the number of stitches in the making of a shirt.



FRENCH SEAM

Stitches in collar, four rows, 3000; across ends of same, 500; buttonhole and sewing on button, 150; gathering neck and sewing on collar, 1204; stitching the wristbands, 1228; ends of wristbands, 68; buttonholes in wristbands, 148; hemming slits, 264; gathering sleeves, 840; setting on wristbands, 1468; stitching on shoulder straps, 1880; hemming the bosom, 393; sewing up side seams of sleeves, 2554; cording bosom, 1104;

"tapping" the sleeves, 1526; sewing all other seams and setting side gussets, 4322; total number of stitches, 20,649.

Hand and Machine Stitching. When one compares hand and machine forms of stitches and forms of embroidery or trimming of any kind, he will find the following:

1. Finer effects can be obtained by hand sewing, but unless it is well done, even, and fine, it is not as good as machine stitching. The method of comparing two machine-stitched fabrics is to note the number of stitches to the inch. The finer the stitch, the better the grade of the garment.

2. Hand embroidery or trimming is preferred to machine work because it is softer, not so rigid, and more attractive. The machine work can be distinguished from the hand work by noting that the hand work is finer and attached differently on the wrong side.

3. The quality of the thread determines the strength of the seam. Silk is the best, as it improves the appearance and strength.

4. Seams should not be cut too close.

5. Stitching should not run off, as it then fails to hold.

6. Folds are sometimes turned under in such a way as not to be caught by stitching.

7. Embroidery and other trimmings should be straight.

8. Fastenings should be evenly sewed on.

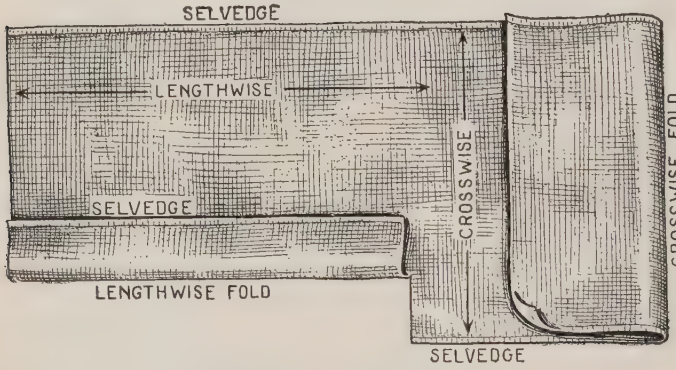
9. Buttonholes should be properly made and reinforced.

How to Cut a Piece of Cloth. A piece of cloth is laid out very carefully by the mill designer to conform to

certain specifications. While the cloth may differ in details, the general structure of the fabric follows a uniform plan. To illustrate: All fabrics are finished at the outer edges with a woven border called a selvedge.

The cloth may be cut or folded (*a*) lengthwise, (*b*) crosswise, or (*c*) on a true bias.

A fabric has two sides: right and wrong. The right side has been finished, that is, it is the side of the fabric



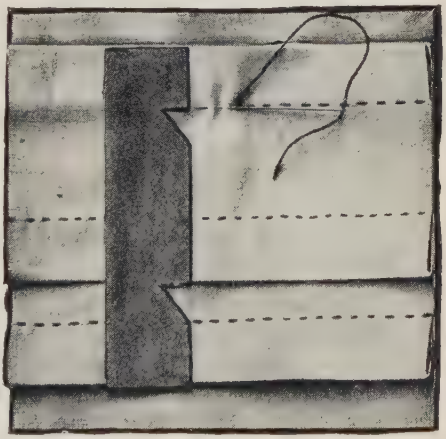
LENGTHWISE AND CROSSWISE FOLDS

that has come in contact with the finishing machines. The selvedge is usually smoother on the right than the wrong side. In a serge or diagonal weave, the twills run downward from left to right on the right side of the materials. In folding cloth, the right side is folded inside to protect it from becoming shopworn.

Grain of Cloth. There are certain fabrics like broadcloth, velvets, etc., that have a distinct nap or pile. In cutting out a costume or suit of these fabrics, it is necessary to have the pieces put together so that the

nap runs in the same direction. Otherwise, the light will be reflected so that the garment will appear to be made from two shades of the same color.

When a pile or nap fabric is finished, the pile or nap is brushed in one direction by the finishing machine. When one runs his hand over a napped fabric, he will find that one direction feels softer than the other. The softer direction represents the grain of the cloth or the direction of the nap. When the light strikes the cloth in the direction of the grain, it is reflected at a different angle from the reflection against the grain, due to the different angles of the projecting nap. Then two lusters appear like two different shades.



TUCKS

Pleat (also *plait*). A flattened gather or fold; an overlapping fold made by doubling cloth in narrow strips upon itself.

Tuck. In needlework, a flat fold in the fabric, or in a part of a garment, fixed in place by stitches, and often one of a series laid parallel; a tuck differs from a pleat in that the former is stitched in position from end to end, while the latter is sewed part way from the top and then pressed into position. Tucks are used either for decoration, or in order to dispose of extra material in a garment, with a view to letting it out as the wearer grows or as the fabric shrinks.

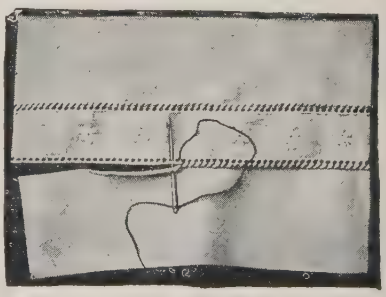
Tucking consists of material ornamented with parallel rows of tucks, either arranged close together and covering the surface, or in clusters with spaces between. It is used for women's summer waists, yokes, underwear, and skirts, and as fronts for men's shirts.

EDGING

Trimmings are placed on garments by either hand or machine. The principal ones are braid, beads, embroideries, lace. The braid trimmings change from season to season according to style. Braid is one of the best trimmings because it is usually strong and light, and for this reason is more serviceable than the others.

Edging is narrow lace or embroidery especially made for trimming frills and parts of dresses. It is usually made with one straight edge and one scalloped.

Galloon is a narrow fabric made of lace, embroidery, or braid. Some of it is made with a mixture of metallic threads, composed of threads or cords covered with gold, silver, or gilt, etc., and is used for ornamenting uniforms.

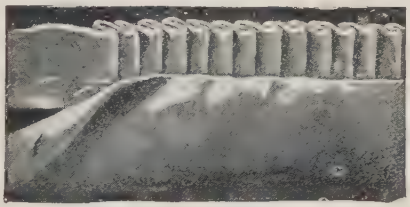


INSERTION

Insertion, or *inserting*, is narrow lace or embroidery or other ornamental material especially made for inserting into a plain fabric. Insertion is made with both edges alike, usually straight, and with a certain amount of plain work on either edge for use in sewing it into the fabric.

Neck Ruffling is a strip of textile material, drawn up at one edge in gathers or pleats, especially prepared for wearing around the neck.

Ruching is a full quilling or pleating of net, lace, ribbon, or other material, used as a trimming for women's garments or worn at the neck or wrists, in widths ranging from 1 to 3 inches. It usually consists of two or more rows of material arranged in box or shell pleats or in the form of quilling.



RUCHING

Flouncing is a textile material of any description used in making deep ruffles or flounces. Flouncings are usually gathered or pleated at one edge and loose at the other, the gathered edge being sewn to the garment.

Fluting is ruffling made with a flute-shaped crimp.

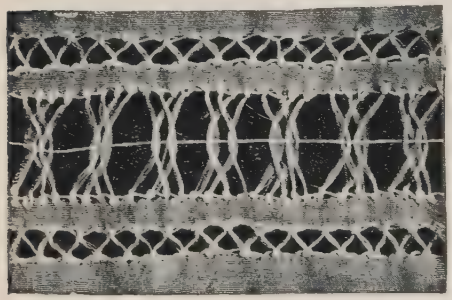
FLOUNCING

Quilling is a narrow border of lace, net, or ribbon, pleated or fluted so as to resemble a row of quills; it is a variety of ruffling.

Tambour Work originally meant a kind of embroidery worked by hand on muslin tightly stretched by means of hoops or a frame similiar to that encircling a tambour. It is now usually applied to work made on the embroidery machine, in which the tambour stitch is used. This stitch produces a pattern of straight ridges crossing each other in every direction at right or acute angles.

Appliqué in dress and upholstery usage means applied or sewn on. An article is appliquéd within the legal sense when it is ornamented with a pattern of lace which may be sewn on a new ground, or with embroidered flowers which may be secured to silk net; in such cases the pattern ornament is said to be appliqué.

Drawn-work. This is a kind of ornamental work done in textile fabrics by pulling out or drawing to one side some of the threads of the fabric, while leaving others, or by drawing all into a new form, producing various fanciful patterns. This drawn thread work is the simplest kind of lace. The early name for it was cut-work. Modern drawn-work is generally left in patterns of more or less complexity without the addition of needlework.



DRAWN-WORK

Drawn thread work is produced in limited quantities in various countries, particularly in Ireland. It has been a favorite occupation from time immemorial in Turkish harems, and the popular and artistic Bulgarian embroideries are liberally interspersed with it. Within recent years some beautiful work has been produced at St. Augustine, Florida, and it is also found among semi-civilized workers, as in Mexico, Ecuador, Brazil, and Peru. The skill of the Mexican women in the manufacture of linen drawn-work is well known. In this a thread is drawn out of a linen fabric here and there, and those that are left are caught together according to a design (often very elaborate), by which the original fabric is entirely lost sight of, but yet remains the base of the whole. From a simple square of white linen the Mexican workers will draw out threads and catch and cross and twist the strands that remain until the result is a filmy texture as delicate as the spider's web — yet sufficiently strong to withstand innumerable washings without losing any of its graceful shape. All the work is done by hand

and each piece is a work of art. Drawn-work is used for a great variety of decorative purposes, as altar cloths, table covers, doilies, tidies, scarfs, shawls, fichus, etc. (See Cut-work lace.)

Fabrics are often divided into two classes, according to width: broad and narrow. For example, we have a broad silk, such as crêpe de Chine, and narrow silks, such as ribbons. We have other narrow fabrics, such as the following:

Banding is a narrow fabric, either woven or braided, intended for use as a band to encircle such things as hats, caps, and cigar bundles. It is also used as a border on articles of dress, as the waistband, wristband, or neckband.

Belting is a narrow fabric, either woven or braided, intended for use in making belts or girdles to encircle the waist.

Binding is a narrow fabric, either woven or braided, used to secure the edges of cloth or of a garment either to strengthen it or to prevent fraying or raveling; examples: skirt binding, coat binding, and carpet binding.

Bone Casings are narrow tubular fabrics, either woven or braided, used as a covering (casing) for corset and dress steels.

Braces, Suspenders, and Garters are articles made from narrow elastic fabrics woven with the addition of India rubber threads in the warp.

Tubings, including circular elastics, are fabrics woven or braided in tubular form.

Webbing is a name commonly applied to narrow woven or braided fabrics which are intended for strength or to bear weight, as a belt or surcingle or suspender webbing.

Cords are made by braiding together three or more threads; the larger the number of threads, the more nearly does the cross-section of the resulting cord approach a circle.

Tassels are made by twisting or braiding together threads which are cut into a certain length and gathered together at one end.

Passementerie. This is a general name for heavy edgings and trimmings made of gimp, braid, cord, beads, and the like, and used for the decoration of women's gowns, wraps, and hats. The passementerie used in the United States is for the most part im-

ported from Germany and France, being produced by the cheap peasant labor of those countries. The raw material used in the manufacture embraces narrow silk gimp, ribbon, braid, and cord, jet, metal, pearl and glass beads, together with buckram, satin, and various kinds of cloth for the foundation work. The beads are obtained chiefly from Coblentz in Germany and Venice in Italy, the other materials required being mainly of local production. The design for the passementerie is first drawn on a thick strip of paper and given to a worker. The latter then sews on narrow silk cord, gimp, or buckram, according to what the foundation of the trimming is to be, and follows the pattern, basting this over it through the paper, and tacking the gimp or buckram firmly at different points to form the figure. When this is accomplished, the basting threads are cut and the design is complete upon the foundation. In the next process comes the slow work of ornamentation by beads.

QUESTIONS

1. (*a*) What is raw cloth?
   (*b*) What causes loose threads to appear on the torn or cut edges of cloth?
   (*c*) How can the edges be made attractive?
2. (*a*) What is a hem?
   (*b*) How is it made?
3. (*a*) What is a stitch?
   (*b*) How does stitching differ from weaving?
4. (*a*) Name the different kinds of the most important stitches.
   (*b*) Draw a sketch of each one.
   (*c*) For what is each one needed?
5. (*a*) What is hemstitching?
   (*b*) How is it produced?
   (*c*) State the value of this stitch.
6. What is the (*a*) bias of a cloth? (*b*) fold? (*c*) tuck? (*d*) pleat? (*e*) ruffle?
7. (*a*) What are the different forms or classes of ornamentation used on costumes?
   (*b*) Describe each.

CHAPTER XXV

CARE OF TEXTILES

Care of Textiles. When one considers (1) the large amount of an income spent on clothes, (2) that few people know how to purchase clothing adapted to their appearance, and (3) that the majority do not know how to take care of their clothing, it is in the interest of economy to aid the purchaser in these matters. One's appearance depends to a large degree upon the clothing he wears.

A well-dressed person has a feeling of assurance and confidence that is a valuable aid to success. Therefore, it is essential for one to know what styles, colors, and lines are the most becoming to him.

Then one should consider how durable a fabric is; that is, its ability to be worn without breaking through; or how serviceable, that is, adaptability to many purposes; the cost of upkeep, cleaning, and repairing; whether it will spot, look shabby, stretch, or become shiny.

Fibers (Length). The longer the fiber, the finer the yarn can be spun; that is, the thinner it can be made, and the more twist can be placed in it. A fine yarn will make a fine fabric. The longer the fiber, the fewer fiber ends will project on the surface of the yarn. Smooth yarn will make smooth cloth, which in turn will catch less dust.

Elasticity. Cloth that is elastic is softer and drapes better than cloth made of fabrics of less elasticity. Cloth made from fibers with considerable elasticity will not wrinkle so quickly as cloth made from fibers of less elasticity. The fibers may be arranged according to elasticity, as follows: silk, wool, cotton, linen, artificial silk.

Absorbing Power. Fibers may be arranged according to absorbing power, as follows: linen, wool, cotton, silk. Cotton naturally absorbs moisture quickly, but does not dry as quickly as linen. Hence a cotton handkerchief or underwear saturated with perspiration or water feels clammy and uncomfortable. Wool absorbs more moisture than cotton, but does it very slowly, and retains the moisture without feeling damp and cold. It gives off moisture (dries) more quickly, and therefore it is used for raincoats, bathing suits, and sweaters.

Weave. A loosely woven fabric with a plain warp and filling yarn will soon become soiled, but it is easily cleaned. On the other hand, a closely woven fabric is not so easily soiled, but retains the dirt more tenaciously. In some forms of underwear, the honeycomb or cell weaving is adopted, being designed to absorb perspiration quickly; such fabrics require very careful washing.

Union fabrics must be treated very carefully, as if they were composed of all weak fiber. Thus, a wool and cotton garment requires the treatment of an all-wool garment; otherwise, an unequal shrinkage will take place.

Weaving imperfections, such as loose threads or knots, cause considerable trouble in laundering. Sometimes in weaving a thread breaks, and the ends must be tied together. When it is finished, the knot may be cut, but the loose thread remains. These spots become weak in the fabric and account for the wearing of the holes which appear, particularly in linens after they have been washed two or three times.

Overloaded Fabrics. If only a normal amount of sizing has been used, no harm is done, because in washing the sizing comes out and the threads swell in ironing, the swollen threads filling the openings. But if a soluble mucilage or sticky material is used, it may withstand several washings before it is removed.

Sizing acts as a protective agency and prevents dirt and stains from penetrating the fibers. On the other hand, it is mostly absorbent and will turn yellow on the action of the atmosphere. There are two kinds of starching, — light and heavy. The light starching is used for table linen, as it enables stains to be removed much more quickly, — the tannin in the tea, and coffee stains, being neutralized by the starch and coloring matter absorbed by it. High and moderate finishes tend to protect fabrics from becoming soiled.

In order to clean fabrics, it is necessary to know their physical and chemical properties: (1) Some are absorbent, (2) some are unaffected by heat and moisture, (3) others swell, shrink, or harden when exposed to heat.

Fabrics will last longer if they are looked over regu-

larly, brushed, cleaned, " aired," mended, pressed (if clothing), and placed on a hanger.

Brushing. Fuzzy or napped fabrics take the dust more easily than hard surfaced fabrics. It is not possible to avoid more or less dust and grease stains on clothing. The dust from the street, sweepings of the room, and the condensation of greasy vapors fall on fabrics of all kinds. Therefore, fabrics should be frequently brushed with a good whisk broom. If the fabric has lint or is inclined to be "nappy," a dampened whisk broom will remove the dust. If there are stains on the fabrics, they should be removed very quickly, according to direction on page 517. Clothing naturally absorbs perspiration, etc., from the body. If garments are frequently exposed to the air, they will feel and appear better. Clothing should be frequently examined to see if any portion is defective, due to " tear," breakage of yarn, or to friction. It is easier to repair small breaks than large ones.

Textile Sewing and Mending. Moth holes, tears and missing threads frequently damage cloth. These defects may be remedied in the following way:

(1) Remove any loose threads from the defects.

(2) Take similar yarn from the selvedge or cloth.

(3) Weave the yarn in warp as shown in the design so as to take the place of the missing yarn.

(4) Weave the yarn in the filling in the same way.

(5) Cut off the loose ends and press the cloth.

Stains include grease spots, juices of vegetables and fruits, splashes from beverages (tea, coffee, etc.), or

napkins, table cloths, and doilies; heavy grease, gravy, etc., on kitchencloths; perspiration stains and blood on body linen. Sugar and resins make awkward stains as they are sticky and soluble under ordinary conditions. Roughened fibers of wool and cotton are likely to pick and retain the soiling matter more easily than the smoother silk and linen. Absorbent fibers will take up more perspiration and moisture and retain them, while the stains on the harder linen and ramie are easily removed. Moist heat causes wool to shrink, and owing to the serration of fibers, it becomes interlocked and matted. We find this effect produced by perspiration on underwear. Moreover, perspiration contains alkaline salts, and these quickly attack animal substance, making it hairy and drying up the natural cell oil. Often woolens stained with perspiration are so matted and heavy that they are difficult to clean.

Some Points to be Considered in the Use of Clothing.

1. Two light-weight garments are warmer than one heavy weight.

2. For outer garments a close weave is better than an open weave, because it prevents a too free passage of air.

3. Garments worn next to the body should be open in weave, light in weight, and provide ventilation.

The amount of heat conducted by a garment depends not so much upon the combinations of fiber as upon the amount of air held in its meshes. Air not in motion (still air) is a poor conductor of heat. Furs are warm owing to the air imprisoned among the hairs.

QUESTIONS

1. Why is it necessary to conserve textiles?
2. What is the value of good dress?
3. What relation does the (*a*) length of the fiber, (*b*) elasticity, (*c*) absorbing power, and (*d*) weave bear to the wearing qualities of the fabric?
4. Explain briefly the usual means for the proper care of clothing.
5. What are the disadvantages of loaded fabrics?
6. Explain the theory of cleaning cotton fabrics.
7. Describe the different types of stains and how they are removed.

CHAPTER XXVI

COSTUME DESIGN

A knowledge of costume design is very important in the textile industry. Since every costume has a definite style, it is necessary to have the proper cloth to make it. To illustrate: If the style of coats and capes is to be loose, then elaborate silk linings with novelty designs must be produced so as to display the interior of the loose garments. On the other hand, if the style tends towards close-fitting costumes — tailor made — there is no need for elaborately designed silks, but simple stripes and dots will be used. The same relation exists in the case of blouses; if the style calls for sheer material, then crêpes and voiles will be used. One must be able to interpret style relations in order to know the fabrics that will be popular and good sellers.

The history of dress shows that styles are repeated in cycles according to the various tastes of the day, which in turn are influenced by many external circumstances. Certain styles or fashions last a few years and are known as period styles.

In describing a style or fashion it is customary to include the following:

(1) The outline or profile of the costume, filled in with black and called the silhouette.

(2) The texture of the fabric used.

(3) Details of finish, decoration, and other accessories.

The success of a costume depends upon four things: style, material, construction, and finish. The appropriate style varies for different people, and those of discriminating taste will choose a costume (either ready-made or made to order) on lines (shape) that are best suited for them or their type, and in colors and materials that emphasize their good points and minimize their weak ones. All this means that we should adopt a style that best becomes us. A simple knowledge of colors and materials is necessary so that we may select those that make us pleasing.

Kind of Material. The effect of a dress depends to a large degree upon the selection of the proper material. Each style calls for a certain type of fabric, and if the fabric of an old costume is used in making a new one, the style effect is lost because it gives the appearance of being out of date. A stiff silk like taffeta should not be used to give a bouffant effect in a style period when fashions were soft and clinging; a soft, clinging material like crêpe de Chine might be used. For the same reason chiffon — a very light, sheer, silk fabric — should not be used for a circular skirt, because it lacks body and stiffness. It might be used as an overslip where a stronger fabric was used beneath. Taffeta, satin, etc., would be used as a suitable material for a circular skirt.

Psychological Effects. (*After-images.*) One of the purposes of textile fabrics, particularly decorative fabrics and certain dress goods, is to appeal to the eye.

In order to appeal to the eye with success, we must know something about the influences that attract it and leave a pleasing impression.

When you look at a fabric, a picture or image of it is projected by means of a lens in the eye on a very delicate nerve organ called the *retina*. It is from this retina that the impressions are carried to the brain, where they help to form our ideas about the fabric. The retina is very sensitive, and sometimes it is possible to deceive the eye (through optical illusions) and make fabrics or costumes appear better than they actually are. To illustrate: Draw two lines the same length and place arrowheads on each one, as shown. The line with the arrowheads pointing outward appears longer than the other line. This is due to the after-image on the retina. As we look at both lines, the line with the arrowheads pointing outward leaves an after-image elongating or stretching the line, while the other line with the arrowheads pointing inward leaves an image shortening the line.

In order to secure the most pleasing effects, it is important to remember the psychological principles of lines, texture (see page 522), and color (see page 523) in designing textiles and costumes. The following are some of the more important principles:

1. Straight-line effects in costumes tend to give an air of dignity and stability to the wearer.

2. A vertical line tends to give the effect of elongation

or pushing upward. This tendency may be increased by means of sharp projecting lines similar to the arrowheads. It may also be increased by the repetition of parallel lines close together, as in the lines of trouserings or hair lines in suitings. The repetition emphasizes the effect of simple lines. The nearer the lines are together, the better effect. Parallel lines widely separated do not give this lengthening effect to any marked degree.

3. A horizontal line gives an image or idea of broadening effect. Many horizontal lines quite close together make an image that tends to go upward and increase in height. If the horizontal lines are far apart, they increase the broadening effect of one horizontal line.

4. Curved lines on the figure are of two kinds: slight curves and sharp curves. These two types have been fashionable at different periods of costume history. From a distinctly artistic point of view, slight curves, especially gentle curves approaching or tending toward the straight line, are more pleasing than the straight lines or the sharp curved lines of the figure.

5. The reflective power of a fabric makes it conspicuous. A person who does not care to make his size conspicuous should wear fabrics of a dull rather than a bright effect. To illustrate: Silk reflects the light more than wool or cotton. A tightly woven smooth fabric with narrow stripes in dark colors makes one appear taller than a loosely woven or napped fabric in bright colors, checks, or wide stripes.

6. Draping fabrics do not give the effect of increasing

the size of the wearer to the same degree as stiff or hard fabrics.

The human form when clothed may be considered as divided into the following horizontal lines on the height:

.....Head line.
.....Neck line.
.....Bust line.
.....Waist or belt line.

.....Skirt line.
.....Foot line.

The model figure has certain definite relations between these lines. Most costumes are made for the model figure. For those who have not a model figure, it is possible to raise or lower the belt line or add trimming to the dress so as to emphasize the good and modify the poor points.

The principle of color harmony should be applied to dress and complexion. If you have a pale, white skin, wear colors that will make it appear more ruddy. Soft greens and light shades of blue (with a greenish tinge) are very effective because they tend to tint the skin with their complementary colors, which are, respectively, red and orange. One should wear cream rather than dead white and avoid glossy white.

If your skin is too ruddy, wear colors that tend to bleach it, such as black, dark blue, and bluish white.

If your complexion is sallow, avoid purple or lilac, as these shades will cast a tinge of yellow (their complementary color) over your face. Wear old-gold, maize,

golden browns, deep russet, old rose, and avoid blues and blacks.

If you have a rich-toned, dark skin with plenty of color, wear cold blues and greens and neutral shades such as dark olive, russet, deep slate, warm gray, and mixed colors. Light colors will increase the richness of your skin, while dark ones will subdue it.

History of Costume. In order to understand the development of dress, it may assist us to trace briefly the history of costume, dividing the history into different ages or periods, and then note the characteristic dress of the more important nations that have contributed to the costumes of to-day.

The first costumes were: (1) the skins of animals, followed by fabrics of pressed (felted) goats' hair and sheep's wool, used by the people of the cold countries; (2) linen, silk, and cotton fabrics, used by the people in the warm countries. Sometimes the body and the fabrics were stained by leaves and berries.

The shape of the first garment in the cold countries was that of the skin hung from the shoulders over the body, and the different parts were held together by strips of tough skin and muscle. In the warm countries, the first garment consisted of a cloth made of grass or reeds or of cotton or linen, hanging from the hip to the knees. The cloth was held in place by a belt or girdle. The women of the colder countries sometimes wore in addition a fur or leather jacket, and in the warmer countries a long, flowing dress of cotton or linen.

As time went on, the dress or costume of each civiliza-

tion or country expressed itself through temperament and spirit in different forms, lines, and colorings. We can divide the history of costume into three great divisions: (1) Oriental, (2) Classical, (3) Germanic.

Egyptian Period. The Egyptian type of dress represents the oriental division. The linen cloth worn by the first inhabitants developed into a longer, circular cloth that surrounded the lower half of the body. It varied in length and folds and really became a skirt. At one time, a triangular, short, plaited petticoat in the form of a kilt was used. Later both men and women wore over this skirt a loose, flowing garment extending from the neck to the feet. The fabrics used at first were coarse linens, but as time went on, the nobility used fine linens, and the outer skirts at different times were held together by eyes and staples (looped) or by a belt (girdled), or arranged in folds on the body (draped). Fancy girdles, belts, and ornamental aprons, etc., were highly developed and ornamented with flowers in soft colors.

EGYPTIAN COSTUMES

Classical Period. The dress during the classical period may be represented by that of the Greeks and Romans. The Greeks had simple tastes in dress and did

not borrow any of the highly colored and ornamented costumes from the oriental countries. The outer dress consisted of a garment composed of a rectangular piece of cloth, measuring twice the height and width of the body. The fabric was folded and allowed to drape on the left shoulder, where it was fastened at first by thorns, later by pins, buttons, or clasps. Men of high rank wore an additional piece of clothing, a broad cloak thrown in loose folds about the person. The dress of the men and that of the women were quite similar, although the women wore their clothing more full and flowing in order to appear more graceful. The material used was white cotton. At a later period the cotton was dyed, particularly by the nobility, who preferred purple coloring with gold.

CLASSIC GREEK COSTUME

ROMAN WEARING TOGA

The costume worn by the Romans was similar to that of the Greeks. At first it consisted of a single garment called a *tunic*. Afterwards, the men adopted a loose garment (*toga*) thrown in folds about the person, and the women wore in addition a shawl large enough to cover the whole figure. During the prosperous times

of the Roman empire and republic, the dress became expensive and was made of wool, fine cotton, linen, and silks elaborately trimmed. The women began to wear expensive jewelry and personal ornaments.

Gallo-Roman Period. France seems to be the style center for women. This is due to two reasons: (1) The French government has sought to make it the style center by encouraging artists and schools for designers and dressmakers; (2) the French women from the peasant to the nobility have a distinctly artistic sense for dress and delight in frequent changes of wearing apparel. A history of costumes in France would really be a historical background for costumes of to-day, since modern costumes are based upon the dress of the past with modifications.

The section of Europe occupied by France was originally called Gaul and was conquered by the Romans, who introduced their style of dress, etc., with modifications. The costumes worn by the Gallic women after the Roman conquest were many and very elaborate, particularly those of the women of wealth. The style is called that of the Gallo-Roman period and consisted of the following:

1. The tunic reached to the ground and was gathered by a belt or girdle at the waist; a band adjusted it to the bosom. The garment fell in folds and allowed only tips of shoes to be seen.
2. A set of boneless corsets to support the bosom.
3. Some women wore a chemise made of cotton, linen, or silk, scalloped at the edge.

4. A short apron with embroidery was frequently worn.

5. A mantilla or veiling was worn to cover the face and a scarf for the head.

6. Plain and embroidered handkerchiefs.

7. Narrow bands of cloth resembling ribbon.

8. Women showed a decided taste for showy colors and various types of dressing gowns and robes of ceremony.

Merovingian Period (452 to 490 A.D.). After the fall of Rome in 476, the empire was divided and settled by the Germanic tribes — Franks, Vandals, and Goths. Clovis, king of the Frankish tribe, ruled France and made Paris the capital. He made definite plans to kill the Roman influence, particularly in dress. The result was that a tremendous change took place in costumes. The Frankish women, who were large and coarsely built, wore a long black gown with an opening for the head and a slit for the arms. The garment was held in place by a girdle. The arms and bosom were uncovered. In addition the women wore a wrap wound around the body and fastened over the right shoulder. Little by little, the Germanic form of dress increased in extravagance and splendor.

Feudal Period (888 to 1100 A.D.). During this period some of the costumes conformed to the shape of the body and became tightly fitted, revealing the lines of the figure. Some were made high, completely covering the neck. The long tunic was fastened at the waist and closed at the wrist.

Middle Ages Period (1100 to 1610 A.D.) This period was characterized by a tendency to overdress. The women wore long, tight-fitting robes, with a decorated band or collar; the sleeves and wraps were long; a large hood was attached with a flowing veil. External corsets made of silk were worn. Fancy headdresses and accessories were common. Sometimes the sleeves

COSTUMES OF LADIES DURING THE LATER MIDDLE AGES

were slashed at the shoulder to show undergarments. Furs and velvets were worn indoors because of the poorly heated houses.

The men wore highly elaborate clothing: breeches, surcoats, coats, shoes, and stockings. Sleeves were long.

The general effect was to have the costume broad, with a capacious effect. All garments were padded stiff, and were hot and uncomfortable to wear.

The costumes worn by the women in the warmer countries, like Italy, consisted of gowns, loose and

flowing, made of soft, clinging material; wide sleeves; square necks; girdled at the waistline.

The above periods are usually classified by the trade under the term *Moyen Âge*. This period includes all the French and Italian costumes of the periods before the Renaissance. Since the Moyen Âge period is really the starting-point for costume designing to-day, it may be well to summarize its essential features:

1. Close-fitting bodice, following the natural lines, extending to the hips, and held close to the figure by a broad band.
2. Free use of embroidery.
3. The use of a girdle, either double or single, tied in front, with long, hanging ends.

This period was revived by the Parisian designers in 1908.

Renaissance Period. Most of the ideas in costume to-day are taken from styles since the Renaissance. We may say that modern fashion began with this period. Beginning with this time French and English fashions went together step by step, so constant references are made to both the English and French periods.

For a hundred and fifty years after the Renaissance, men dressed as elaborately as women and in some cases more so. In fact, many modern ideas in fashion are drawn from men's and not from women's costumes. Ladies wore frilled skirts, tight at the waist, and over a rich petticoat; the hips were padded with whalebone and steel. A large ruff was worn about the neck by both men and women. Men wore felt hats with wide brims,

and overcoats with tight sleeves. The coats were pointed in front, short, and tight fitting.

Stuart Period (*Louis XIII and Charles I*). These periods include the picturesque costumes of the cavaliers in England and the mousquetaries in France. The principal parts of the costumes were, a broad hat of velvet, with a large ostrich plume, over a face having a

COSTUMES OF THE RENAISSANCE PERIOD

pointed beard and on a head with long curly locks. The stiff, starched ruffle of a former period has been changed to a falling ruffle of lace and embroidery. The shoulder width is increased by curved epaulets. A richly ornamented belt supported the sword. The breeches were loose and tied at the knee with ribbons. Long gauntlets and a short cloak trimmed with lace and with a silk lining completed the costume.

The women wore sleeves to the elbow, loose and

richly ornamented, and the corsage long and pointed. The large skirts were gathered at the waist and trimmed around the bottom with embroidery, often raised to show a petticoat of rich material. The overskirt and sheer embroidered underskirt of to-day is taken from this period.

During this period we find some well-known styles that have been handed down to us. The following represent the most important:

1. The ruff collar worn at the neck was introduced by Catherine de Medici, widow of King Henry III of France. She was of Italian birth, and inherited an artistic sense, greatly influencing France during her reign.

2. During the reign of Henry VIII men's dress reached the highest degree of elaboration. Plain and untrimmed frills at the neck and wrist were used. The general effect was to make the lower part of the body broad.

3. The Mary Stuart collar is among the styles handed down to us by Mary, Queen of Scots, who had married Francis I of France.

4. The hoopskirt effect was introduced during this period, and very stiff cotton fabrics, such as crinoline, were manufactured. This hoopskirt effect was revived again as an extended hip effect in 1918.

5. The long-waisted, pointed bodice effect that has been frequently renewed was introduced during this period.

Louis XIV Period. This period was noted for exaggeration in style. The men wore wigs, and large, round

castor hats trimmed with feathers. The tight-fitting body garment had increased in length and was decorated with lace of gold or other material. It was buttoned from the neck to the waist, and the skirts were made open. The coat was made without collar or lapel and was open at the neck to show the waistcoat. A lace necktie was carelessly knotted around the throat. The sleeves of the coat were rather loose and were turned up so as to be quite short, showing ruffled shirt sleeves of fine cambric. The front, shoulders, and cuffs of the coat were richly laced. The breeches were of moderate width and were tied at the knees with ribbons. High shoes gave way to low shoes with a buckle of gold or silver. Toward the close of the reign, men's dress became simpler, although still elaborate in trimmings.

MARY STUART, QUEEN OF SCOTS

Women's corsage was décolleté, the bodice rather pointed, the sleeves less than elbow length, with long folds of lace. Long gloves were fashionable. The skirts were full, rather simple, short in front, with fullness given at the sides and back by means of an overskirt open at the front. This style is common to-day. The hairdressing of the women was similar to that of the men.

Louis XV Period. This was a continuation of the previous period with the following changes: kid and netted gloves took the place of badly shaped leather gloves. The draped bustle was extensively used; this style was revived in 1885.

PERIOD OF LOUIS XIII AND LOUIS XIV

Louis XVI Period. This period was noted for many fashions, such as the powdered wig and white lace collar similar to those we see in pictures of Revolutionary men and women; light shoes with buckles, and high shoes for riding; gaiters buttoned on foot and leg during bad weather. Waistcoats became part of women's clothing. Lace ruffles were worn at the wrist and a lace cravat at the neck. The tricornered hat was richly adorned with lace and silver. Madame de Pompadour, leader behind the throne, introduced the combed-back hair. The bodice was décolleté and trimmed around the edges with small floral designs (Pompadour designs). It was made over an undervest and laced up the front in corset style to

resemble the appearance of the peasant girls. The skirts were decorated at the bottom and knee with flounces, and were looped up.

Louis XVI married an Austrian princess, Marie Antoinette, who delighted in playing rustic scenes after the paintings of Watteau. Parks were transformed into dancing courts, and a new style was devised every week to carry out new ideas. The following changes were important: the figure became narrower and the bust and bustle were exaggerated.

PERIOD OF LOUIS XVI (left) AND DIRECTOIRE (right)

French Revolution. After the French Revolution, the pendulum of style swung the other way, and simplicity of dress took the place of extravagance. Men wore the following: Long trousers of dull colors, long greatcoats, cutaway coats, and dark hats. The clothes were arranged badly and fitted badly. The women wore simple, short-waisted dresses, with a kerchief around the neck, crossed over the bosom, and knotted at the waist behind.

Directoire Period (1795–1799). This period represents the styles in vogue while the government was conducted by the directory. During these years Greek fashions were revived. Transparent materials were popular; skirts were trailing and were slit from the hem to the knee or waist. Women cut their hair and wore wigs. The men were very careful about their dress and introduced the Directoire coat with a short front and cutaway lines.

PERIODS OF EMPIRE AND RESTORATION

Empire Period. During this period the government was under the control of Napoleon. It was noted for bad taste in dress and manners. Greek fashions prevailed, with the short-waisted effect called Empire style. The gowns had long skirts of simple lines, with the waist too short and too low. Hats and bonnets were ugly, large, and elaborately trimmed. Artificial flowers were used.

Restoration Period (1814–1848). During this period, particularly at the beginning, the styles were ugly, due

to long shoulders, enormous sleeves of elbow length, and huge hoops, throwing the whole figure out of proportion. Skirts were full and short. The front of the hair was usually parted and curled so that the curls were arranged at each side.

Second Republic Period. The costumes were a continuation of those of the restoration period with the following modifications: Longer shoulder lines and small waists. Small black lace mantles were popular. Black velvet bands were used at the wrist and throat.

PERIODS FROM 1830 TO 1850

Second Empire Period. During this period the silhouette changed. The gown was made long-waisted, with basque and voluminous train; this did not change until 1850, owing to the influence of Empress Eugénie. Skirts became very large with the aid of crinoline, and the bodice was tight fitting with rather tight sleeves. In 1859 there was a strong tendency to Turkish jackets and dress accessories — fan, parasol, handkerchief, smell-

ing salts, etc. Headgear consisted of a " pork pie " hat, a simple round hat without brim, trimmed with quill or ostrich plumes. This hat was revived in 1901 as a polo hat. The pannier effect was introduced during this period. The skirt was held up high at the back and extended.

PERIOD FROM 1860 TO 1870

Third Republic Period. The dress continued the styles of the preceding period with the bustle prominent. The skirts were made plain and pulled back by string so as to fit with snugness in the front. Later they were made very tight all around to such an extent as to make it difficult for one to sit down. They were sometimes ornamented with as many as twenty flounces on a single skirt. The hair was dressed high and was moved over the forehead. Dressmakers and tailors began to sell ready-made clothing.

The following represent the characteristic costumes worn by different nations that have influenced modern styles:

Byzantine (VI–IX centuries). The costumes consisted of straight, hanging robes of rich silks heavily embroidered with gold and stones.

Spanish Peasants. The characteristic is the mantilla (of oriental origin) of black lace over a lady's head held up with a large comb worn in the back of the hair. The bottom of the skirt is always richly trimmed. This applies to the dress of all southern European peasants.

Russian. The costumes of the northern and eastern Russians include a short, flaring jacket (sleeveless) with the yoke made of different materials; the skirt is full, and most of the costumes show beauty, richness, and variety.

Bohemian. The costumes include: large embroidered cap; embroidered sleeves or colored ribbons. Red is one of the favorite colors. The apron is elaborately decorated. A flower wreath denotes an unmarried girl.

Modern Greek. The costumes include coats with rich gold embroidery on red or green velvet; trouser effects due to Turkish influences.

Chinese. The costume of the Chinese consists of a robe, plain or embroidered, and trousers. The coat sleeves are wide.

Japanese. The costume includes a long kimono fastened by a sash with a bow in the back.

Since the last generation modern costumes have been made better for the following reasons: invention of worsteds which give a straight line — tailored effect — to the clothing of both men and women (worsteds were invented during the middle of the 19th century; prior to

this only light and heavy woolens were used); tendency on part of women to wear more comfortable clothing, invention of highly twisted yarn forms such as crêpes and voiles. There has been available greater wealth of color than ever before due to the invention of new dyestuffs. There are now a greater number of weaves of fabrics from which to select.

The history of cloaks and shawls furnishes an interesting background to the development of the ready made women's clothing industry of America.

Cloak. (Derived from Anglo-Saxon *clokke* [clock], which piece of mechanism when first made was the shape of a bell, and sounded the hours with a clapper. The cloak as originally introduced was circular in form and when it was drawn about the throat resembled a bell, hence the name.) Properly, a loose outer garment without sleeves, worn by either sex as a protection against the weather; at present, however, the name is applied to any sort of sleeved wrap, long or short, worn by women. Though a garment of great antiquity, the general form has varied but little in the course of centuries, save in being at times short or long, ornamental or useful. The cloak has frequently been common to both sexes, and in England during the reign of Edward IV (1441–1483) it was legally regulated as to the length it should be cut and the class of persons who should be allowed to wear it. Cloaks of light and costly materials have been worn by men, particularly in England and France, at different periods. It was one of these garments which Sir Walter Raleigh threw upon the muddy ground so that Queen Elizabeth might pass by with dry shoes. Under the name of *Spanish cloak* this garment was worn to a limited extent in the United States from 1800 to 1840. The shape was that of a half circle finished with a broad collar of velvet or fur, which was continued down the edges of the cloak on both sides. The same garment is still worn as the most common winter dress in Spain and Italy.

From the Revolutionary days until about 1810, American

women usually wore shawls of one kind or another for protection and warmth during the winter. Shortly after 1810, however, there came into use a most sensible garment, no doubt the outcome of actual necessity. This was the *pelisse*, a long sleeved cloak extending almost to the ground and usually trimmed or lined with fur. Once established, this became a long-enduring fashion, despite all efforts of the cape and spencer to displace it. All the women after the first decade wore pelisses, usually of their own making. Various kinds of material were used in their construction, such as cloth, fur, silk, satin, and velvet, the latter often in bright and attractive colors. For summer wear there were shorter cloaks and mantles of the dolman order, also silk scarfs and the ever popular spencer. The *spencer jacket*, worn more or less from 1810 until about 1850, was of different styles, but always short, never going much below the waist. From 1840 to 1860 was a period during which shawls were the most popular form of wrap for both summer and winter. These were generally in light colors, with plenty of pattern. *Paisley* and *broché* shawls, together with many fine woolen varieties, were the favorite styles with the majority of women, while for the very rich real Cashmere shawls were imported.

The ready-made cloak was not yet conceived. In New York and Philadelphia a few velvet mantles of circular form and heavily beaded were made up by certain large stores for special customers, but that was all. One of the earliest steps in the evolution of the modern cloak was an attempt to adapt the shawl. It was cut into a semi-jacket form, and made what was then considered a very creditable appearance. The first avowed candidate for the position of the dethroned shawl was the silk mantilla, which was first made by a few eastern manufacturers, during the early seventies. From this graceful garment fashion turned to sacques, both loose and close. The earliest of these, made of cloth, was merely a loose jacket, some 40 inches in length. In the manufacture of these jackets smooth beaver cloth was chiefly used, and little attempt at ornamentation was made. For several years the changes in styles were very gradual. At that day every woman had her wrap made for her by her dressmaker, or made it herself if she could do so and needed to be economical. In either case

the model was derived from the fashion-plate, and the service of the dry goods store in the transaction was confined to the sale of the cloth and trimmings.

Shawl. (From Persian, *shal*, a shawl or mantle.) A square or oblong article of dress, forming a loose covering for the shoulders, worn chiefly by women. Shawls are made in a wide range of sizes and are composed of different materials, as silk, cotton, hair, or wool; and occasionally they are woven of a mixture of some or all of these staples. The shawl is supposed to have originated in Persia, in which country, as well as in India, it has from time immemorial constituted the most characteristic and important article of dress among the natives. Essentially the same piece of clothing, but in various forms and under different names, is found in all parts of the world. The shawls made in the Valley of the Cashmere occupy a preëminent place among textile products, and the *Cashmere shawl* is characterized by the great elaboration and minute detail of its design, in which the "cone" pattern is a prominent feature, and by the glowing harmony, brilliance, depth, and enduring qualities of its colors. The basis of these excellencies is found in the raw material of the shawl, which consists of the very fine, soft, flossy underwool of the Thibet or Cashmere goat. There are several varieties of the Cashmere shawl, according to districts in which it is produced; but apart from shape and pattern there are only two principal classes: (1) The loom-woven shawls called *tiliwala,* sometimes fashioned in one piece, but more often in small segments which are sewed together with such precision and neatness that the seams are quite imperceptible; such loom-woven shawls have borders of silk, the weight and stiffness of which serve to stretch the shawl and make it set properly. (2) *Embroidered shawls*, called *amliker*, in which over a fine twilled ground is worked by a needle a minute and elaborate pattern. A large proportion of the inhabitants of Srinagar, the capital of Cashmere, are engaged in the shawl industry, and there are numerous colonies of shawl weavers settled at Amritser, Nurpur, and other towns in the Punjab. Amritser is now the principal *entrepôt* of the shawl trade between India and foreign countries. Imitation Cashmere shawls are made at Lyons and Nimes in France, at Norwich, England, and at *Paisley,* Scotland. Some of the products of these localities

are but little inferior in beauty and elaboration to Oriental shawls; but owing to the fluctuations of fashion there has been little demand for the finer products of European looms for many years.

The name Cashmere is also used to designate a variety of light weight, plain-colored shawls made of twilled cashmere dress fabric. These are commonly dyed black and fringed, and are especially worn by elderly women. Cashmere shawls are made both " single " and " double "; the former range in size from 62 × 66 to 72 × 72 inches, the latter from 67 × 135 to 72 × 144.

The *Shetland shawl* is a fine, light-weight knitted or crocheted variety, made by the inhabitants of the Shetland Islands. The wool of which the genuine Shetlands are made is obtained from a native breed of sheep, which in some respects resembles the famous Cashmere goats. The yarn is spun and prepared by the native women, who also knit the shawls. These fabrics have long been in favor for their warmth and exceeding lightness. The acme of perfection in the production of Shetland shawls seems to have been reached in a specimen exhibited in 1890 at Lerwick, Shetland Islands, which was entirely of hand work, the wool being hand carded and hand spun. This shawl measures $2\frac{1}{2}$ yards square and weighs but three ounces. It contains 10,200 yards of two-ply yarn of dazzling whiteness, and is knitted in a most intricate and varied pattern. Owing to its exceeding lightness and softness, it is said that it can easily be passed through an ordinary finger-ring.

The manufacture of woven shawls was first begun at Norwich, England, in 1784, though it was not until 1805 that a woolen shawl was produced entirely by the loom. At present the larger portion of the ordinary and medium grades of goods used in the United States are of domestic production, the finer qualities being imported. The beaver shawl is a heavy, single, reversible, all-wool variety, commonly weighing from $2\frac{1}{4}$ to 4 pounds. Its use is largely confined to elderly women and country people. In size beaver shawls range from 66 × 66 to 72 × 72 inches. What are known as double wool shawls are of lighter weight and finer texture than the beaver; in weight seldom exceeding 3 pounds; in size usually 67 × 135 and 72 × 144 inches. Single wool shawls are produced in sizes ranging from 66 × 66 to 72 × 72 inches. The *shoulder*

shawl is a small square variety made both of cotton and of wool, dyed in plain colors and ornamented with simple patterns of checks and stripes; in size ranging from 36 × 36 to 47 × 47 inches. It is also called a breakfast shawl.

History of the Cloak Industry. It is an interesting bit of history to trace the early beginning of the cloak business as a separate industry, and to follow the steps which mark its development. When heavy cloaks came into fashion (1865–1870), it was discovered that the individual manufacture was not satisfactory. The average dressmaker was expensive and not over skilful. A good fit was by no means sure, and when completed the cloak did not compare favorably with the clothing of men. The seams were not pressed down; there was no " shrinking on " of one piece to another to impart plumpness; the flaps or other portions with corners and edges were liable to take on an obtrusive curl; and it was rare that a cloak really fitted the figure, or hung smooth and neat like a coat or an overcoat. Here, then, was a general feeling of dissatisfaction, a desire universal among women for stylish and well-made garments — truly a rich field awaiting those with the ability to till it. About the year 1870 the industry began to develop. At first a few large dry goods houses in New York made up for their own trade a limited number of cloaks from the best Parisian and Vienna models. These were readily disposed of, and in several instances dry goods houses began to devote their entire efforts to cloak-making. From these houses sprang others throughout the country, until today the value of the combined output amounts annually to over $50,000,000. (See page 549.)

The wraps made from 1865 to 1870 were chiefly circulars, jackets, and capes. These at first were cut in only one size and style, although by 1871 several houses were making three sizes, — small, medium, and large. In 1875 the popular style was a long cloak or coat with very loose sleeves called a *raglan*. This was followed in 1879 by the *dolman*, and the latter in 1883 was superseded by the *Newmarket*. In 1880 plush sacques were first worn.

Manufacture of Cloaks. In the early days of cloak-making a fashion was usually good for a whole season, and it was perfectly safe to anticipate the trade by making up a stock beforehand.

But that condition has passed away in the cloak industry, as it has in many other lines. The manufacturer has ceased to be an autocrat, — the public is the autocrat. As a rule, the best cloak houses of the present day occupy large premises. Ample space is needed to manufacture and display a large assortment. Generally the materials are received, examined, and cut, and samples or other single garments are made up under the same roof, where they can be easily submitted to the judgment of the firm. In many cases, however, a large part of the work is done outside of the house, by contract or piece-work, a system that seems almost necessitated on account of the rapidity with which large orders must be executed and the work bunched into short seasons. In making cloaks, when the demand sometimes may be for five or six hundred of a certain style, each piece of cloth to be cut is examined by experts in regard to measure, texture, and color. Then it is sponged by machinery (see page 134) designed especially for the purpose, being so arranged that from the time the cloth starts until it is folded dry it is not touched by the operator. The cloth is then ready for the cutters. If the quantity is large enough for the cutting machine, it is laid in folds and the sharp wheel run through five or six thicknesses at once. After the cloth has been cut according to the pattern provided (see page 548), the bundles are compared with the orders and a ticket made for each garment, so that a complete record is kept of every hand that works on the garment. Next, the cloak goes to the seamers, who use sewing-machines especially adapted to that particular work, and which are provided with a fixed gauge that insures a perfectly uniform seam. Expert hands can work at machines that make 3,000 stitches per minute. The collar, cuffs, facings, etc., of each garment are cut according to the style designed, and with the "body" sent to the workmen who excel at that portion of the labor. After making the buttonholes and sewing on the buttons and ornaments, the garments go to the presser, and then to the final examiners and model, who are responsible for the fit and workmanship. The examiners also see that the materials and trimmings are right, and that any changes that may have been ordered to suit certain customers have been properly made. The cloaks are then ready for packing and shipping.

How Styles are Created To-day. Styles are created by designers in large centers like Paris, London, and New York. Ladies' styles are usually created in Paris by a group of designers called *couturiers*. Men's styles are created in London. The designers create the styles, and if they are approved by society in general, they are sent to New York, where they are often modified to meet conditions. Many of the designs are created in New York.

The creation of styles is due to many influences, such as the changes of season, historical or passing events, the changes favored by dressmakers or tailors.

The division of the year into two parts in the countries of the temperate zones means that everyone must change from heavy to light, and from light to heavy clothing twice a year. Because of these changes it is natural that all should desire new clothes with the change of season. Experience shows that it really takes a year to plan, make, and distribute clothing, so it is necessary to create styles a year in advance. For this reason styles are created in February and August for the following year.

There is practically little if anything entirely new in the styles from year to year. The history of costumes and clothing shows that every country and civilization has its own costumes and clothing for different classes. Years ago textiles were manufactured and sold from stock. The tendency to-day has been to increase the style risks so that it is considered bad judgment to make very many fabrics — except a few cottons and silks that may be converted and a few staple worsteds — for

stock. The aim of every manufacturer is to make goods only on order.

Our costumes and clothing to-day are based on ideas or motifs taken from different periods. Passing events, such as the wars in the Balkans, excavations in Egypt, popular plays based on historical events, suggest ideas to the designers, who immediately plan costumes and clothing suggested by the dress of those periods.

After the designer has created his style, the important point is to have the style adopted and approved. Many designs, as many as hundreds, are created, and the designer feels well repaid if one out of twenty is adopted. The designs are all made into costumes and placed on models or *mannequins* or popular individuals who frequent public places at Easter or during the holidays. The comments made on the different designs are telegraphed to the stylers in the United States, who immediately begin to make fabrics for those that are most acceptable. This speed is necessary, as it requires six months to plan, make, and distribute fabrics. If the fabrics in the popular costumes or styles are not new, then it is not necessary to create new fabrics.

A large number of the popular styles are brought every year from Paris to America. The Parisian designs are modified in response to comments made by American dressmakers, designers, etc., who are very careful to note comments of the public.

Style suggestions for fabrics come from London for men and from Paris for women. These suggestions are received by the expert of each selling house, who is

called a styler. From all the samples that he obtains from Paris and London, aided by information with regard to the tendencies of style in general, he selects to have made for the coming season 200 or 300 fabrics. These fabrics, called blankets, are made at the mill, given to the styler, who then decides on 40 or 50 which the house will offer to the trade. The selling house opens its season with these 40 or 50 novelties plus the regular staples.

While Paris has the tradition of being the style center of the world, New York has advanced to a point where it is the Paris of America. The World War gave Americans an opportunity to gain an appreciation of her costumes. To-day there are in New York a number of prominent costume designers who are making distinctively new creations.

Costumes are designed as follows: A costume maker usually employs a styler who either defines the design or passes upon the designs produced by the designers. In many cases the styler is the proprietor or a member of the firm. There are two methods of designing practiced in making costumes. In most cases the design is developed by draping and pinning material on a dress form or manikin. This is usually done first in crinoline, followed by the finished material. After the draping comes the cutting of the pattern, fitting, and finally the making of the sketch. The other method is to have the costume designed on paper with pencil and color by a costume designer. Then the effect on the material is noted, draping on the model, criticism, and alteration.

Designs for men's clothing have been and will probably continue to be developed in London. The supremacy of English designs is in part due to the great woolen and worsted centers, to the men who know the art of designing materials, and to the English tailors. The nobility, particularly the king and princes, have always taken a personal pride in setting styles.

There are many well-dressed men in this country who desire English cut clothes, so the tailors import the models and make suits and overcoats to correspond.

The majority of American men desire to have a distinctly American style, which is more conservative. This is arranged by the American tailors at yearly conventions in this country.

Styles. Fabrics and costumes may be divided into four classes, appealing to the public — conservative, popular, ultra, and exclusive. Since fabrics like a serge will always be in style, serge may be considered a staple fabric, and the person who wears it as conservative in style. There are certain fabrics that consist of a new weave with high coloring and which usually appeal to young men and women. Such a style is extreme or ultra stylish. On the other hand, midway between these two limits, conservative and ultra, there is a fabric like georgette crêpe that appeals to the majority of people. We call this a popular style. Lastly, there are certain fabrics, like imported satin broadcloth, that are so expensive that only people with considerable means can purchase them, and because they are restricted to this group the fabrics are said to be exclusive in style.

QUESTIONS

1. Why is a knowledge of the styles of costumes essential to the intelligent buying of textiles?

2. Name three points of a costume essential in giving a proper description of the style.

3. Describe the first costumes that were worn.

4. What are the chief characteristics of the costumes worn in oriental countries?

5. What determines the dress or costume of a period or a country?

6. (*a*) What do you know of the costumes worn by the ancient Greeks and Romans?

(*b*) How did the Classical period differ from the Oriental period?

7. What was the Gallo-Roman period? Describe its characteristic costumes.

8. What are the characteristics of the Merovingian costumes?

9. (*a*) What is meant by the Feudal period of dress?

(*b*) Give briefly the characteristics.

10. (*a*) Describe the costumes worn during the Middle Ages period.

(*b*) State the characteristics of the Italian costume.

11. (*a*) The *Moyen Âge* period is frequently mentioned in fashion papers. What were the characteristics of the costumes of this period?

(*b*) What from this period has influenced the costumes of to-day?

12. (*a*) What is meant by the term Renaissance?

(*b*) Why is this an important period?

(*c*) Give the characteristics of the costumes of both men and women during this period.

13. (*a*) For what is the Stuart style period noted?

(*b*) Name the styles that have been handed down to us to-day.

14. Louis XIV period stands for exaggeration of dress. Give the principal points that illustrate this statement.

15. Give the important contributions to costume made by the Louis XV period.

16. (*a*) Briefly outline the principal points of dress during the Louis XVI period.

(*b*) What character influenced the styles of this period?

17. (*a*) What effect did the French Revolution have on the Louis XVI period?

(*b*) Describe the costumes worn during the French Revolution.

18. What was the characteristic tendency of costumes during the Directoire period?

19. (*a*) What was the Empire period of costume?

(*b*) Describe the prevailing fashions of this period.

20. (*a*) What is meant by the Restoration period?

(*b*) Give the style tendencies.

21. What were the principal characteristics of the Second Republic period?

22. Make a list of the changes noted during the Second Empire period.

23. What were the characteristic features during the Third Republic period?

24. What have been the tendencies in style costume since the Third Republic period?

25. Why have we introduced into style at different times parts of costumes of a national character from the Chinese, Turkish, Balkan, Egyptian, Japanese, and Russian dress?

26. Name the chief styles of the (*a*) Chinese, (*b*) Balkans, (*c*) Russians, (*d*) Japanese, (*e*) Egyptians, and (*f*) Turks.

27. How are styles created to-day?

28. Why has France influenced style?

29. Describe the successful efforts made by New York designers to create distinct American styles.

CHAPTER XXVII

FURS

Furs may be considered in connection with textiles. They contain the fibers of the animals in the original form. Since furs have become very popular there has been a tendency to substitute for them pile woven and napped knitted fabrics made to resemble furs. Therefore, it is important to know the characteristics of the furs themselves and also of the imitation furs — pile fabrics — in order to know the selling points of the substitutes.

Pile Fabrics. The chief artistic value of pile fabrics lies in the display of color obtained by the light striking the upstanding pile. If a pattern is on the pile, then a corresponding variation of color and light takes place. The pattern may be produced in one of five ways: (1) In weaving, by the introduction of colored yarn in the warp and filling; (2) by roller printing, by which color in design is imparted to the pile fabric; (3) by hand block printing better and finer effects may be produced than by roller printing; (4) by embossing, where a design is pressed on the pile fabric so that the portion of the pile enclosed within the design may be raised or flattened; (5) by cutting, when a portion of the pile is cut or eaten by acid to correspond to a design.

In making artificial furs, the pile fabrics pass through a series of complicated processes. In some cases, the pile is carded and combed out so as to stand erect, furry, and beautiful. In other fabrics, the goods are ironed on the face, and the pile is laid flat, when it is called *paon* or *panne* velvet. Other fabrics are converted into imitation furs by block printing to give different color effects and are embossed in parts, the remaining pile being thinned out by combing so as to resemble the best fur.

Imitation furs have certain commercial advantages over natural furs, not only in cheapness but also in the dyeing qualities. They are lighter in weight than animal fur, more sanitary, and easier to clean.

Pile fabrics must be handled with great care. In order to prevent crushing the pile, they are usually wound on steel frames and stretched on hooks so that there is an air space between the back and face of the fabric. When this is done, the projecting pile is not crushed or injured by the weight of the goods or by being wrapped.

Fur. The short, fine, downy coat of certain animals, distinguished from the hair, which is longer and coarser, but more or less of which is generally present with it, is known as *fur*. Fur is one of the most perfect non-conductors of heat, thus a warm covering for animals in cold climates, and admirably adapted for human clothing, either attached to the animal skin or separated from it. The finest kinds, as those of the sable, ermine, seal, beaver, otter, marten, etc., are among the costliest of clothing materials, both on account of their rarity and the amount of labor involved in their preparation. Primitive man knew the value of furs both as a protection against the cold and for purposes of adornment. This appreciation of their worth has come down to us through

the centuries, and each year has added to our knowledge concerning the best methods of dressing furs so that the total improvement in imparting durability and luster has been vast and marked.

Use of Fur. The use of fur in its unmanufactured form is as old as the history of all northern nations. With them the pelt is required to keep out the piercing wind and the driving storm, while the fur and overhair ward off the cold; and they are as much a necessity to-day among the dwellers of the Northland as ever they were in the days of barbarism. The providing of this necessary covering became the first purpose of their toil. Subsequently, furs grew into an article of barter and traffic, at first among themselves, and afterwards with neighboring nations of more temperate climes. With the latter, fur gradually became an article of fashion and of commerce, until to-day its use has grown to be more extensive than at any former period.

Sources of Fur. Northern Europe and Asia long supplied the bulk of all furs used, but the discovery of America with its great variety of furbearing animals quickly changed the current of trade, and to-day the entire world looks to America for its main supply. Otter, sable, mink, beaver, marten, and seal are all at their best in this country. The only high-grade furs that Europe now furnishes are Russian sable, Persian lamb, ermine, astrakhan, and Siberian squirrel. The Indians were induced to seek energetically for furs, and to part with them for a trifling compensation. The French themselves became very expert hunters. There never were more daring and active adventurers than the trappers of the French fur trade. They were the pioneers of the settlements of our western territories and of British America, penetrating into the wildest and most inaccessible regions, braving all perils, and paving the way for the more quiet settlers. Forts were established from time to time by the government throughout the Northwest to protect this trade, the one at Mackinaw becoming an important center; while the enterprise of the traders extended to Hudson Bay on the north, far to the west, and southward along the Mississippi Valley. This trade may be said to have been the most active agency in the settlement of our western territory. Up to 1850 it was the sole interest of Minnesota, while as late as 1844

Lake Superior was visited only by trappers and agents for the numerous fur companies. Although formerly in the hands of large companies possessing special privileges, the fur trade of late years has been conducted by private individuals and firms. Few, if any, monopolies exist. The Alaska Commercial Company enjoys some special privileges for the taking of sealskins on the Pribiloff Islands, and some restrictions exist in Russia, but beyond this the fur trade is a free one the world over. Individual enterprise, skill, and capital have an open field. The once powerful Hudson Bay Company with its chief office in London, still maintains its organization, but enjoys no special grant. It competes in open market with individual traders throughout British America. Its collection of pelts is sold at public auction in London, in January, March, and September of each year. Within the last few years furs have become very fashionable and the demand in America has exceeded the supply.

Fur Markets. Since the settlement of Minnesota, St. Paul and Minneapolis have become important centers for the western fur trade. The Twin Cities are not only a market to which trappers ship their catch, but also a large manufacturing center. They receive the bulk of the skins taken throughout the entire Northwest, and also a good share of those from British America. The other important centers of the fur trade are New York, Boston, Montreal, St. Louis, Detroit, and Chicago. In Europe, London, Paris, and Leipsic are the best markets for American raw furs, as they have long been for those of all other countries. At the annual fair in Leipsic furs in great quantities and of immense value change hands, while the fur trade of London is of enormous proportions.

Preparation of Fur Skins. To prepare fur skins in a way to endure long transportation is a simple and easy matter. When stripped from the animal, the pelt is hung in a cool place to dry and harden; nothing is added to protect it. Care is taken so that the pelts do not heat after packing, and they are occasionally beaten to remove the dust. A marked exception is in the case of sealskins, which are preserved by salting in layers and packing in casks or hogsheads. All other raw furs are marketed in bales. Prime skins are those which have been taken at the season of the year (usually of very short duration) when the fur is fully grown;

"unprime" applies to those caught out of season. Such skins are always less sightly, less durable, and much lower in price than prime skins.

The Intermediate Step. From the animal's back to the finished article there is much skilful handling of high-priced furs. Aside from the trapping and selling and making into fashionable gowns, an intermediate step occurs, and upon this depends the ultimate value of the skin. As a result of this step or process, ordinary skunk skins have been made into beautiful garments, rabbit and cat skins have masqueraded as seal and beaver, while squirrel coats have been made to do duty as many kinds of rare furs. As a trade, this intermediate handling has been little affected by modern inventions in machinery. It still remains primitive, a trade of handwork and footwork and man's labor. No mechanical device has ever been invented that equals in delicacy and results the contact with the flexible human fingers. Machines are utilized for curing and tanning low-grade skins (rabbit, opossum, cat, etc.) and also heavy pelts are put through a machinery process. But the high-grade furs (sable, mink, ermine, chinchilla, marten, etc.) are still manipulated almost entirely by hand.

Dressing. The work of the dresser is interesting and at stages highly picturesque. The skins are turned over to him in the stiff raw state, as sent in by the trapper. In curing, the pelts are first put through a softening process, and then are "tunned." Here they remain in salt and water over night. The skins are wrung out of this bath and partly dried, then turned over to the "flesher," who removes the superfluous flesh and fat from the skins. This is done on upright knives set slantingly at the end of a narrow bench, on which the flesher sits astride. From the flesher the skins go through an oiling process, in which pure creamery butter is liberally slapped on the pelt. In this condition they are placed in heavy oak barrels, which are covered with cloth. In these barrels half-naked men stand waist deep, and tread the skins day after day. With their bare feet they work the butter into the fur and the heat which emanates from their bodies forms a most important item in the curing of the skins. The effect of the heat and butter is to render the skins soft, supple, and glossy. Only a few pelts, from ten to fifteen, according to size, are trodden on at

one time. Sometimes a mixture of egg and oil is used with or without the butter.

When the butter has been thoroughly worked in, the skins are removed to a drying room and spread out upon the floor. At the proper stage of dryness they are taken to the sawdust room. This sawdust in reality is pulverized wood, and about the fineness of sugar. Sometimes it is of mahogany or of rosewood. For different sorts of fur different dusts are used; wood dust for the darker furs and flour and marble dust for ermine. As only ten per cent of the butter is actually absorbed by the pelt, the rest clinging to the fur, the dust has to be worked into the greasy fiber very thoroughly in order to cleanse it. This is usually accomplished by placing about a dozen skins together with a copious supply of wood dust in a big revolving drum, heated by means of steam to about blood heat. The furs and dust are rapidly revolved until sufficient dust has been taken up, when they are removed and deftly shaken. As the butter adheres to the dust, the former is thus got rid of. The skins are next beaten gently and then given over to the " comber." He brushes up their silky coats and trims them into symmetrical shape, when, after being dyed, they are ready for making into garments.

With the above process faithfully worked out, the fur is never fulled or cottony. This system, and the honesty of the trade, has won for American dressers a front rank in the curing of skins. Except for treating Persian lamb, astrakhan, and lynx skins, which is excelled only in Lepsic, and the London finishing of seal, which our climate and chemical condition of water make impossible, the United States leads the world in tanning and dressing furs.

Dyeing of Furs. Furs are dyed in a variety of ways to make them uniform in color and adapt them to the fashion and taste of the hour. The chief feature in the dyeing process consists of preparing a bath of suitable strength and applying it to the fur in such a way that too much of the liquid will not reach the skin, whereby its durability might be ruined. Ordinarily this is a simple and easy process and only becomes an art when employed upon very fine skins, from which the overhair has been first removed by plucking, leaving the fur alone to receive the dyestuff.

Among these are the skins of the muskrat, beaver, otter, and especially the fur seal; the last value depends upon the success of the dyeing process. Muskrat is used for making Hudson Seal furs.

Manufacture of Fur Garments. In manufacturing fur garments the fur is never cut with scissors. The marks of the pattern are made with chalk upon the skin side, and then cut with a sharp knife. The cut is made almost through the skin, but not quite, being finally separated by pulling the edges apart with the hands. The use of scissors would cut the fur on the outside despite the utmost precautions. When the sections of an article or garment are cut out, the edges to be sewed are brought together and moistened, and then sewed overhand with a waxed cotton thread. Silk cuts the skin. All varieties of fur are cut and sewed in practically the same manner.

Low Grade Fur. The business in American furs of the cheaper sort is largely increasing. The ingenuity of manufacturers has triumphed over natural deficiencies to such an extent that certain skins which formerly would not have been tolerated even as trimmings, are now, owing to improved processes of manipulation, transformed into very fair imitations of expensive furs. In some cases this is so cleverly managed that only experts are able to tell the real from the false; wear and tear, however, are infallible means of detection. A large industry, at present carried on principally in Paris and London, though to some extent in this country, is the transformation of rabbit skins into imitation furs. After the skin has been properly dressed it can be finished to resemble seal, Siberian squirrel, mink, marten, beaver, or any other desired fur. In the cities mentioned millions of rabbit skins are dressed and treated, and the bogus furs sent to all parts of the world.

The Dressing of Rabbit Skins. The rabbit skins are purchased soon after they have been stripped from the animals, and are stiff and hard when unpacked in the sorting-room. Experts examine each skin, and those which come up to the standard are sent to the furriers, but the torn, undersized, and punctured pelts are turned over to the felt-maker. The hair of rabbits is of two kinds, the short, soft hairs which make the fur, and the long, stiff hairs which extend beyond the fur. These long hairs are plucked from

the pelt, and the pelt is then ready for treatment by the furrier. After being well dressed with a chemical solution, the skins are strung on iron rods and dried in an oven for some hours; then they are well aired and the legs, tails, and other useless parts are cut off, and the skin made into a sort of bag by sewing the sides together. This bag is turned hair-side in, the flesh side being treated with an oil for the purpose of softening it. Next, in order to render the skins still softer and more flexible, they are worked in a "fulling mill." This latter is merely a large trough in which two wooden hammers continually work up and down. After a few hours' treatment they are as flexible as kid gloves and can be stretched to a considerable degree. The skin is next scraped down by means of sharp knives until it is not much thicker than paper. The operation which follows scraping is that of scouring, which is accomplished by means of large wooden "drums" made to revolve with great rapidity. Each drum holds 400 or 500 rabbit skins, and also a barrel or more of loose sawdust and plaster. As the huge drum revolves the skins tumble over each other on the inside, and the sawdust and plaster reach every part of them, scouring them thoroughly. The skins are treated twice in this manner for several hours at a time; then they are taken to a steam beater, where they are whipped and beaten until the sawdust and plaster are entirely removed.

Next they are carefully combed and brushed and turned over to the "shearers." These workmen, armed with long, sharp scissors, cut the fur to the proper length. If the rabbit or cat skin is to be masqueraded as a "seal," the fur is cut quite close. For "otter" the shearing is not so close, and for "beaver" the fur is left still longer. Rabbit fur may be dyed any desired shade, but for some time previous to dyeing, the skin is soaked in a preparation which permits it to take the color more readily, for the skin is dyed as well as the fur. In this chemical preparation, which is one of the secrets of the furrier's trade, the pelt is soaked several times. After this treatment it is dried in an oven. The actual dyeing is performed by soaking the skins for a day and a night in a vat containing dye matter; when quite dry they are put through the scouring drums again for the purpose of polishing up the fur, after which they are assorted as to quality, packed in bundles,

and sold to the manufacturing furriers, who make them up into coats, cloaks, muffs, hats, caps, and robes.

Imitation Fur. No other class of merchandise admits of so much deception as furs, and many are sold by names unknown to natural history. In the fur business, as in many other departments of commerce, the unscrupulous are ever at work endeavoring to produce imitations, and in few lines has this been carried to such a successful degree. Rabbit and " coney " skins are not the only pelts which are transformed into furs which bear the names of animals living in ice and snow. Monkey skins from Africa and South America are sent to the furrier to be made into fine raiment. Large numbers of ordinary Chinese cat skins are utilized to supply the demand for seal and beaver. The shaggy curls of our native fox-tailed squirrels are sold as imitations of rare furs. Muskrat is often blended to imitate mink, and marten to look like Russian sable. The United States buys more imitation furs than any other country, but millions of them are sent to China each year to line the robes of the mandarins. Large numbers of rabbit and cat skins are dressed and dyed in this country but the French have the credit of producing the best imitations.

A brief account is given here of most-used varieties of furs and skins, with some general remarks concerning their average value and customary uses:

Angora. See Angora.

Astrakhan. See Astrakhan, Lamb.

Badger. Size, 2 by 3 feet; overhair coarse, 3 to 4 inches long black with silver spots. Used for robes and brushes. Value from 50 cents to $1.50 per skin.

Bear, Black. Size 3 by 6 feet; overhair 6 to 8 inches long, fine flowing and glossy. Best are from Minnesota, Wisconsin, and Michigan. Used for robes, coats, capes, and mittens. Value of best, from $15 to $30.

Bear, Brown. Same size as black; overhair very fine. Best from Hudson Bay territory. Used for muffs and garniture. Value, from $25 to $75.

Bear, Grizzly. Larger than the black; coarse, grayish, shaggy hair. Found only in Western United States. Used for robes and coats. Value, from $7 to $20.

Bear, White or Polar. Largest of the bear family; hair short and rigid; color, pure white. Found only in the Arctic regions. Used as robes. Value, $50 to $100.

Beaver. Size, 2 by 3 feet; overhair 3 inches long, coarse and of brown color; fur thick, fine, and greyish. Found in limited numbers through the western states and territories of America. Best are from British America. Used in every form and fashion in all civilized countries. Value, $3 to $8 per skin; beaver castor, from $6 to $8 per pound.

Cat, Civet. In size about the same as the domestic cat, but slenderer; brownish-grey color, with furry tail marked with black and white rings. Found in western United States and Mexico. Value, 10 to 25 cents.

Cat, Domestic. Too well known to require description. Value of black skins, 5 to 30 cents; all other colors, 5 to 8 cents. Used in the manufacture of imitation furs.

Cat, Wild. Overhair and fur thin and coarse; color, grey. Use very limited. Value, 25 to 75 cents.

Chinchilla. Size, 8 by 12 inches; overhair and fur of equal length, the latter remarkably fine, soft, and downy; color, silver-grey or dark-grey. Best are from Peru and Chile. Used for muffs, boas, borders for garments, and linings for cloaks, pelisses, etc. Value, $1 to $3.

Coney. A corruption of *conepatus*, the name of a genus of badger-like skunks. The most common variety is the white-backed, bushy tailed skunk of Texas, Colorado, and Mexico. In trade, the term "coney" is used indiscriminately to designate cheap, inferior fur of several kinds, particularly that of rabbits, cats, etc.

Electric Seal. A fanciful name given to a variety of manufactured fur made in imitation of genuine seal. It is made from muskrat, coney, skunk, and various other inferior varieties of fur.

Ermine. Size, 4 by 10 inches; overhair and fur fine, soft and close; color, pure white, tip of tail black. Best are from Siberia. Used for muffs, garments, and linings. Value, 25 cents to $1.50.

Fisher. Size, 15 by 39 inches; overhair fine, long, and glossy; fur very close; color, black or greyish. A right noble skin. Used for muffs, boas, etc., and often sold for marten and sable. Value,

$5 to $10, according to color, black being the most highly prized. Also called black fox, pekan, and wejack.

Fox, Black and Silver. Size, 2 by 4 feet; overhair thick and fine; varied in color from a fine silvery grey to a beautiful blue black; fur close and curly. Its beauty places it at the head of all fancy furs; the tail is a royal brush. The choicest are from British America. Used for muffs, boas, and lining of robes. Value, from $50 to $300.

Fox, Cross. Not so large as the silver, with a fine overhair having a shade of red at points. The skin shows a dark cross on the shoulders, hence the name. Best are from Hudson Bay territory. Value, $7 to $25.

Fox, Red. Common throughout the United States, and too well known to require a description. Value, $1.25 to $4. White foxes, found in Labrador, are valued at from 50 cents to $3. Gray foxes, with gray overhair, sprinkled with silver on the back and yellow on the sides, are valued from 50 cents to $1. Kitt foxes, or swifts, as they are sometimes called, are the smallest of the fox family. The back is pure gray, sides yellow, and belly white. Value, 25 to 75 cents.

Goat. Size variable; overhair of many species thick and glossy. Although not a fur skin, the pelt is frequently used as a substitute for real fur. A large percentage of the buggy robes now sold as wild animal fur are dyed goatskins, and the so-called real monkey-skin muffs and capes are for the most part straight-haired goatskin dyed black. (See Angora, Rug.)

Lamb. The finest, dark, close-curled lambskins come from Persia. The next grade comes from Crimea, a province in southern Russia. The hair of these Crimean skins is short, curly, and of a greyish or bluish color; in trade usually termed "krimmer" or "crimmer." Excellent skins also come from Astrakhan, a Russian province to the east of Crimea. All of these are produced by a peculiar breed of Russian sheep, which thrive and grow curly wool nowhere except upon their native pasturage. The three varieties are highly prized by furriers, being extensively used for women's garments and trimmings. The finest Persian lambskins are worth from $3 to $5 per skin; krimmers, $1.50 to $2; astrakhans, 50 cents to $1 (import duty added). The city of Leipsic, in

Saxony, has long enjoyed a high reputation for the excellence of its dyed Persian lambskins. (See Astrakhan.)

Lynx. Size, 2 by 3½ feet; overhair fine and flowing; of a clear, silver-blue shade, sprinkled with black. Value, $2 to $6.

Marmot. Size, from 4 by 8 inches to 8 by 12 inches; overhair coarse; fur inferior; color, from whitish-grey to dark brown. Used in the manufacture of imitation furs. Value, from 10 to 50 cents. Also known as ground-hog and woodchuck.

Marten, Pine. Size, 6 by 18 inches; overhair fine and flowing, 1 to 2 inches long; fur close, thick, glossy, and very durable; color of the best, a dark coffee brown; of poorest, pale yellow. The marten is the third most valuable North American fur. It is hardly distinguishable from the Russian sable, though usually not quite so dark in color. Value of best dark pelts, $25, and from $2 to $10 for medium grades and pale colors.

Marten, Stone. Found only in Europe; the best come from Hungary and Turkey. Distinguished from our native pine marten by the dull greyish or stone color of the fur. Value, $2 to $5.

Marten, Russian. See Sable.

Mink. Size, 6 by 15 inches; overhair shorter and slightly more rigid than that of the marten, but vies with the latter in elegance of luster. The color of the choicest skins is a rich, dark chestnut brown. Inferior and less prized skins range from pale to dark brown. Best are from Maine and Canada, but the animal is abundant in nearly all the heavily timbered parts of the United States. Used for muffs, boas, wraps, trimmings, etc. Value, from $1 to $3.

Mole. Size, 3 by 3 to 5 inches; fur short, fine, and soft; color, grey. Used for purses, etc. Value, 10 cents.

Monkey. From the west coast of Africa; has long, thin, flowing hair; of various colors, principally black and dun grey. In limited use by furriers for muffs, boas, and capes. Value, from 25 cents to $2. Much of the long hair sold under the name of monkey hair is in reality obtained from the Angora goat. In length and luster the latter equals the best monkey hair, and when properly dyed it is difficult to distinguish them.

Muskrat. A well-known and popular fur in the United States. Size, 8 by 12 inches; overhair coarse and light brown; fur fine,

thick and silky; in general favor with furriers and available for a great variety of purposes, particularly for men's winter caps and in the manufacture of felt for hats. It is one of the commonest quadrupeds in this country, and especially prolific in cultivated regions, living in rivers, lakes, and ponds. The annual catch varies from 2 to 5 million skins. Value, from 5 to 25 cents. A variety of black muskrat from Delaware and Maryland is worth double these prices. Also called musquash.

Nutria. From La Plata, South America; in size and value between the beaver and the muskrat. The fur is used chiefly in the manufacture of felt for hats. Value of prime fur, $3 per pound.

Opossum. Size, 8 by 15 inches; overhair long, coarse, and whitish-grey; fur, woolly. Best comes from Ohio. Used in the manufacture of felt for hats and of imitation furs. Value, 10 to 60 cents.

Otter, Common. Found in all northern countries, and formerly very common throughout the United States. At present the greatest number of skins secured in this country comes from the dense cane-brake regions from Alabama, Georgia, and Mississippi; the best and darkest skins come from Michigan, Wisconsin, and Canada. Size of best, $1\frac{1}{2}$ by 3 feet. The color is blackish-brown to dark greyish. Used for capes, jackets, collarettes, muffs, and trimmings. The prime otter is never more beautiful than when used with the long "guard hairs" untouched. The pelt then shows shiny and lustrous, and exhibits true prismatic tints in the bright sunlight. When plucked of these long overhairs, the inner fur, soft and deep, is exposed, closely resembling in appearance the fur of the beaver. The latter is useless unless plucked. Garments of northern otter are generally regarded as the most desirable and the handsomest (except seal) that can be manufactured of fur. When properly cared for they will wear from 10 to 15 years. Value of northern otter, from $8 to $15; of southern, from $4 to $8.

Otter, Sea. Found only in the North Pacific ocean, principally along the coast of Alaska. Size, 2 by 6 feet; overhair exceedingly fine and extending but little beyond the fur, which itself is very thick and indescribably soft and silky; color, dark brown, occasionally with silver points regularly interspersed. The poorest skins are not more valuable than the beaver, but fine, choice

specimens command from $300 to $500. The sea otter is almost extinct, and the few skins that are annually taken are as a rule purchased by the very wealthy.

Persian Lamb. See Lamb.

Rabbit. Size, 10 by 16 inches; overhair coarse; fur thick and fine; color, all shades from black to white. Best are found in Europe. Used for imitation furs and in the manufacture of felt for hats. Value of domestic skins, from 1 to 5 cents.

Raccoon. One of the most peculiar and valuable pelts of the United States, the animal flourishing best in cultivated regions. Size, 1 by 2 feet; overhair not particularly fine, but bright and lustrous, 3 inches long, thick and flowing. The fur when dressed resembles beaver, ranging from black and silver-blue to grey-brown and deep coffee-brown; best are from Michigan, Indiana, and Ohio. Average price of prime, $1 to $2. Some specimens vie with the fisher in its peculiar shade, and some even with the silver-fox, such rare skins commanding from $5 to $20.

Sable, Russian. These skins are in the highest estimation with furriers. Size, about the same as our American pine marten, to which it is closely related. The overhair of the sable, however, is much more fine and flowing. There are three kinds of hair in the pelt — a short, soft, dense fur; a second set of longer hairs, somewhat kinky, and a few long, glistening hairs, bristly to the very roots; color, dark brown or blackish and occasionally of a rich bluish shade. The pelt is very soft, tough, and durable. The best are from Siberia, where the trade in them forms an important industry. Inferior grades come from central Russia and lower Amoor. Very choice pelts of a brown color are furnished by Kamchatka. Value of darkest skins, from $100 to $400; inferior sorts bring a much less price. In its natural state sable is never dead black, but is often dyed in black in the same manner as sealskin.

Seal. See Sealskin.

Skunk. Size, 10 by 16 inches; overhair fine, thick, glossy, and flowing, 3 inches long; color, black or blackish. Many species have two white stripes, more or less broad, extending from the head to the tail. It is now easy to deodorize the skin, and the fur has become very popular. When dressed and dyed it is sometimes known as " Alaskan sable." The best skins come from New York

and Ohio. Value of best black pelts, $1.60; other colors range from 50 cents to $1.50.

Squirrel. Size, 3 by 8 inches; overhair and fur equally fine, the latter short, close, and very durable. The bulk of the supply comes from northern Europe and Asia; best are from Siberia; color pale blue to clear dark blue. This fur is in great demand among furriers for muffs and linings, as well as for large garments. Tails are long and bushy and well adapted for boas and artist's brushes. The American squirrel, both the gray and the red species, are used in a limited way for muffs and boas.

Wolf. The timber or grey wolf measures from 3 to 5 feet in length, the prairie wolf or coyote being much smaller. Found in the Western States and Canada. Overhair long, coarse, and flowing; the usual color of the timber wolf is a grizzled grey, while that of the coyote is a greyish brown. Value of former, $1.50 to $4; of latter, $1 to $2.50. Used for robes, coats, and mats.

Wolverene. Length from 2 to 3 feet; overhair coarse, from 2 to 3 inches long, very shaggy and of blackish or brownish with a lighter band of color on each side of the rump. The pelt is valuable, being much used for robes, rugs, and mats, in which the whitish bands of the fur used exhibit a set of oval figures when several skins are sewed together. Value, $2 to $6.

Really good fur is but slightly higher now than it has ever been, and the taste for this kind is never likely to die out. Good fur is akin to fine gems, in that it will always command admiration, respect, and a proper price. It is altogether probable, however, that the finest furs will eventually acquire something of the value that attaches to rare bits of old lace, now treasured as heirlooms in many families, and which were wrought with infinite care and patience years ago when the world was less absorbed in the rush and ceaseless activity that now possess it. There is danger of the complete extermination of fur-bearing animals in America, due to extensive hunting and the spreading of civilization over the wilds of the country.

QUESTIONS

1. What is a fur? Why can a fur be classed as a textile?
2. Why have furs proved to be so popular?
3. (*a*) What textile fabrics in structure resemble furs?
   (*b*) Describe the manufacture of a pile fabric.
   (*c*) How may it be colored?
   (*d*) How may it be striped?
   (*e*) How may it be thinned?
4. How many patterns can be made in a pile fabric?
5. What is a panne velvet?
6. State the advantages of a pile fabric (artificial fur) over natural fur.
7. Describe the physical characteristics of fur.
8. Why is fur adapted for human clothing?
9. Name the finest kinds of natural furs.
10. Name the countries that supply most of the furs.
11. State the steps used for preparing furs for the market.
12. Why are furs dyed?
13. Describe the manufacture of fur garments.
14. What are the lower grade furs? How are they treated?
15. How are skins prepared to endure long transportation?
16. Where are the fur centers located as regards the supply.
17. What animals are used in the production of imitation furs?

CHAPTER XXVIII

ARTIFICIAL FLOWERS AND FEATHERS

Artificial Flowers. An artificial flower is an imitation of a natural flower, worn by women as an ornament in the hair, on hats, gowns, etc. There is perhaps no one article handled by the dry goods trade which is more captivating to the eye and imagination than these delicate accessories to feminine toilet, and there are few branches of ornamental work which have within recent times shown a greater increase in importance than that of artificial flower-making. Not only has the trade itself greatly extended within the last few years, but the improvement in the manufacture is very marked. The bouquets and wreaths used in the trimming of bonnets and dresses may be said to almost rival nature, so truly and delicately are the individual flowers made.

Artificial flower-making is almost entirely done by hand, giving occupation principally to young women and children, the majority of whom, both in France and in this country, work in small shops. It is not exclusively woman's work, however, for men are employed in cutting out the material for the flowers, either with a die or a stamp machine. The materials employed for their production are muslin, silk, satin, velvet, and to a limited extent gauze, feathers, paper, wax, shell, and prepared glass. Muslin is the material most extensively used. The initial stage in the manufacture is that of starching short lengths of the fabric. When thoroughly dry, the starched strips are folded in many thicknesses and

handed over to a cutter. The cutting is usually done by hand, although machines are used in some instances. The workman who performs this part of the labor places the muslin, dried and folded, upon a block of lead, and with a sharp-edged steel die and a heavy mallet cuts it into the form of petals. One vigorous blow is generally sufficient to drive the heavy die through the folds and prepare from 10 to 20 petals for the next operation. Cutting machines pierce through from 24 to 48 thicknesses, according to the material used. Leaves are cut out in the same manner as petals.

Dyeing. The silk or muslin petals are taken to the dye-room, where girls, and in some cases men, with quick, deft fingers, saturate whole layers of them with the desired color. As many as 40 or 50 of these petal shapes can be handled at the same time when they are small and need only to be saturated, but when the shapes are large and need a treatment of different colors, it is necessary to paint them singly. In handling the smaller shapes the thumb and forefinger of the operative are pressed tightly against the center of the layer when dipped into the dye, so as to prevent the color from reaching that spot. When a more elaborate effect is required, the operator uses a brush, and with a few quick dashes places the different colors upon the petal.

Metallic Parts. Leaves of all sorts are veined with metal patterns, and also with the brush after the muslin sheets have received the proper shade of green. The crimped appearance of the natural leaf is imparted by pressing in a machine. A small wire is then pasted along the center of each leaf, and they are tied up in large numbers, ready for use or shipment. After the muslin shapes intended for the petals of the flowers have been properly dyed, they are placed on large sheets of blotting paper extended on frames, where they remain until thoroughly dry. Hundreds of metal dies are needed to cut out all the pieces required to compose the different kinds of flowers. Some minor parts are brought to this country from abroad already prepared, as, for instance, the rubber tubing used for the larger stems. The assembling of the different parts is done by girls, and is the most fascinating part of flower-making. The most artistic artificial flower is perhaps a rose. This flower is always in demand, and, with the violet, is more ex-

tensively used than any other. The rose is also the costliest, as it is the most complicated flower and forms almost a little industry of itself. The petals of cheaper sorts are cut out in a bunch, all hanging together at the center, but in the better grades the petals are cut out one by one and then pasted together by hand. Each piece is taken up separately by a girl armed with a pair of pincers, who, with one dexterous movement, fashions it deftly into the shape of the flower, and then passes it on to a more skilful worker, who gives a more precise form to the petal. A third girl attaches each petal to a very fine wire, around which thread or paper has been previously twisted to form the stalk. The remaining operations consist in goffering the petals and leaves to give them a curl, or perhaps a crimpy appearance. Such work as this cannot be done hastily, for it is far more like that of the artist than of the mechanic. A small piece of cotton forms the center of the flower. To this the wire stem is fastened, and then the petals are drawn up, in the cheaper kinds, or pasted on if the rose is to be a fine one. This process is continued until all the petals have been attached. Then the wire is covered with painted rubber tubing, the thorns gummed on, and the buds and leaves added. Sometimes they are waxed or dusted with fine powdered glass or potato flour, to represent the "bloom." After the finishing touches have been put on, they are carefully packed in pasteboard boxes. Processes similar to those employed in rose-making are applied to the making of all other flowers, though there is naturally a difference in some of the minor operations, depending upon the character of the production.

It is usually stated in works of reference that the making of artificial flowers began in Italy during the first years of the 18th century. The modern trade certainly had such an origin, but, as a matter of fact, artificial flowers date much farther back. The Egyptians made them of thin plates of horn variously stained, and the Romans also were very skilful in imitating natural blooms in wax. Leaves of various trees and plants plated with gold and silver were also known to both these nations.

Feathers. Feathers of different kinds are used frequently for the decoration of hats. The principal one is the *ostrich feather*. The feathers of the ostrich have long been known and used as

ornaments for the hats and costumes of women and for the uniform hats of men. The ostrich is a native of Africa, though since 1878 it has been bred to a small extent in southern California. The chief supply of feathers is furnished by Egypt and South Africa. In both these sections many large farms are wholly devoted to the rearing of the birds for their feathers. At the plucking season the birds are collected from different parts of the farm and driven into the plucking-kraal, where they are enclosed in small pens. The outlet of each pen is through a plucking-box, into which, one by one, the birds are driven to be denuded of their plumes. The box holds the bird so tightly that he is unable to turn or move about. A few rapid snips from the shears of two workmen, one standing on either side of the box, soon divest the bird of his finest feathers. They are usually cut before the quills are quite "ripe," or ready to fall out, so that the tips may be perfect and not draggled or destroyed. The feathers on the back, extremities, wings, and tail of the ostrich are the most valuable, the long white feathers on the wing bringing the highest price. Black-and-white, drab, and ivory are the natural colors. There are no black plumes on the birds, these being produced by dyeing the all-white ones. The raw feathers are worth from $10 to $100 per pound, according to their quality and width. The length ranges from 5 to 22 inches, the longest being used for plumes and the shorter for tips. Ostrich feather manufacture employs about 10,000 operatives in the United States. The majority are women and girls. The remuneration received by feather workers is said to be considerably higher than that in any similar industry. No machinery of any kind is used in the various processes, the work being entirely performed by hand.

Treatment. Raw ostrich feathers, as landed in this country, pass through no less than eighteen processes before they become the plumes and tips of commerce. On arriving at the factory, the first operation is stringing, in order that they may be handled more quickly and to better advantage. The long strings are then taken to the scouring-room, where the second process begins. Here they are carefully washed in tubs, on washboards, with castile soap, by powerful men scrubbers. Still in the strings, the feathers are next dyed; or, if they are to be finished in light colors,

the natural dark shade is extracted. The next process is a second scrubbing, after which they are carefully dried. Girls now take the feathers in hand and assort them carefully according to quality, length, etc. Then follow selecting, piecing, paring, sewing, stemming with wire, and divers minor operations. All of the plumes of commerce are really double plumes, made by uniting two (or more) of the natural feathers. This is accomplished by paring down the stems and sewing them together, back to back. Tips are also often composed of several small sections neatly joined together and trimmed.

After the sewing and wiring comes the steaming process, in which the feathers are passed over jets of steam from boiling kettles to render them soft and pliable. Following the steaming comes curling. This represents the most artistic part of the work, and experts command high wages. The next operation is that of bending or shaping the feathers, this being effected by means of a small knife which the workman deftly manipulates, bending the wire a trifle here and there, and gradually but gently coaxing the feather into a graceful form. From the bender the plumes and tips go to the buncher, who arranges them neatly in bunches of threes and sews them in pasteboard boxes, after which they are ready for shipment to the trade.

Characteristics. A full-grown ostrich weighs about 300 pounds, and when its neck is stretched it stands over 8 feet from the ground. The birds are first plucked at the age of 6 months, and again 9 months later, and at every succeeding 9 months thereafter. The chicken feathers — the first plucking, known as spadonas — are of little value, seldom bringing over $12 per bird. The second plucking, at the age of 15 months, is of higher value, bringing from $25 to $40 per bird. At the age of two years the ostrich has fully matured and produces really fine feathers, the pluckings bringing from $75 to $150, according to their quality and the state of the market. In each wing, over the protector or floss feathers, grow 26 long plumes. In the male these are pure white, but the female adds slight shadings of écru or gray. The sweep of short feathers above the splendid fan of white is plucked for tips; each wing furnishing 75 of these. The tail feathers are toned into deep ivory, of which there are 65 adapted to commercial use.

The weight of the feathers and the richness of their plumage depend somewhat upon the care taken in not extracting them too early, but more especially upon the quality of pasturage provided. If the bird is given a plentiful supply of food, the feathers will grow and ripen more quickly, and may be plucked every seven months. Ostrich feather dealing has long been a recognized and established trade in London and New York markets, imports coming principally from Tripoli, Magada, Aleppo, Alexandria, and the Cape of Good Hope, while California also contributes to the supply.

QUESTIONS

1. Why may artificial flowers be considered a form of textiles?
2. (*a*) Why are artificial flowers used?
   (*b*) State the importance of artificial flowers.
3. Describe the manufacture of artificial flowers.
4. What are the most popular artificial flowers?
5. (*a*) Why may feathers be considered a form of textiles?
   (*b*) Why are feathers used?
6. What is the most popular feather used?
7. (*a*) Describe method of obtaining ostrich feathers.
   (*b*) Which are considered the best?
8. Describe the method of making ostrich feathers into plumes.
9. Tell how the feathers are marketed.

CHAPTER XXIX

PERIOD DECORATION

The Desire to Decorate. The desire to decorate or beautify is so natural an impulse that we find from the beginning of the human race traces of different kinds of textile decoration. In response to this desire, decorations were copied from nature, flowers, birds, and scenery.

Since decorations are expected to be pleasing, it is only natural that people should select designs and colors of only the most beautiful flowers, scenes, and symbols of pleasure and religion, as well as those of conquest and other achievements. As most of these were in the form of textiles, the history of decorative fabrics follows very closely the history of man since the time he first sheltered his family.

Each civilization, race, country, and class of people has adopted a form of decoration, and each distinct form may be called a Period Decoration. To illustrate, there is the Egyptian period decoration, which represents the designs used during the early Egyptian civilization.

The designs of people in one part of the world are different from those in another part. This may be due to climatic conditions and environment. The flowers and birds of warm countries near the equator have the most radiant colors, and we find that the people of those

countries use the radiant colors in their clothing and other decorations. As we pass to the north, we notice that the colors of the animals are darker and not so brilliant, and the tastes of the people of the northern countries in dress and decorations tend to darker colors. Following nature's pattern book again, we find that the darkest color values are near the ground and the brightest or lightest values are farther from it. Hence, floor coverings should be in massy colors in subdued tones.

Purpose of Decorative Fabrics. Decorative fabrics may be used instead of pictures for wall decoration. Frequently, decorative fabrics, because of their picturesque qualities, make up the most important and beautiful parts of the furnishings, and to these we owe our aesthetic environment. It must be understood that these hangings should be decorative to the room; that is, the color must harmonize or contrast with the color scheme of the room, and the design must be worthy. For instance, a small figured cretonne would be out of place as a wall hanging. On the other hand, if a cretonne of an elaborate design of pictorial beauty with aesthetic shades were used, it would brighten the wall space and give a touch of dignity to the whole decoration of the room. Formerly, these decorative fabrics were very expensive and were used only by the wealthy, but to-day, due to modern machinery, they are within the reach of all.

The decorative fabrics that are popular to-day are based upon the period decorations of the past, often with some modification. To illustrate, homes of wealthy

and cultured people are often decorated and furnished after the style of one of the periods, so that it is possible for one to be surrounded by designs full of meaning. Our mind works along the law of association, one idea recalling another idea closely related to it. Though we may have only one period in a room, we have a century or more compressed into our vision. It is necessary to know the characteristics of the different periods of decoration in order to appreciate their value. It is also desirable to learn the essential points of good design, such as ornamentation, design, and color.

Proportion. Design is the combination of lines, masses, and color. Lines — either straight, curved, or broken — may be grouped together in such a way as to be either pleasing or unattractive to the eye. If they are pleasing, you will find it is because they are properly spaced or connected in good proportion. If the lines are spaced equally or in simple relation, the eye immediately sees the relation, and it appears so simple and childish that it becomes monotonous. On the other hand, if the mathematical relation is not simple and the proportions not easily seen, then it becomes more interesting.

Another quality that makes a design attractive or interesting is that of balance or symmetry. This is very important in all types of textile designing. Many designs are made up of two parts, at the left and right of an imaginary line passing through the center of the design, so that both the left and right parts are similar. Such a design is dignified and formal, and is called

"symmetrical." On the other hand, there are many attractive designs in textiles in which the balance is properly obtained when the areas are not similar, due to proper balance of the mass of the design. This is spoken of as indirect or unequal balance, and is more attractive but more difficult to design than the symmetrical type.

Variety in Design. Since a design is made up of straight, curved, or broken lines, or combinations of them, it is clear that the design that has a variety of lines will be the more pleasing — due to the contrast — than one that is monotonous. The repetition of the same lines done artistically, that is, so as to appeal to the mind, arouses a feeling of satisfaction and is spoken of as the repetition of the design.

Perspective. A good design must have a form that will appeal to the eye. There are two methods of presenting an object — geometrical and perspective. The *geometrical* is the view of the object made by looking squarely at it and then drawing an outline of it. By changing the point from which one looks, different views of the object may be obtained. The views usually drawn are of the front, top, and side. Of course, to show the interior, additional views of the object may be drawn in sections. The front view, obtained by looking squarely at the object from the front, is called the *elevation*. The top view, obtained by looking squarely at it from the top, is called the *plan*. The side view, obtained by looking squarely at the object from the side, is called the *profile*.

The *perspective* view is the one that portrays an object as it appears to the eye from one point of view. The rails of a car track, for instance, appear to converge. The parallel lines of any object appear to the eye to converge in like manner, and a perspective drawing will show this. Any picture or photograph furnishes an example of perspective. It reproduces the way the eye sees and is the natural method of presenting an object for pleasure. The early oriental artists did not know how to secure perspective; hence, the early drawings and designs appear flat and not natural because they are presented in the geometrical (profile) rather than the perspective manner.

Naturalistic Designs. Patterns may be of two kinds — naturalistic and conventional. The best designs are those that follow nature. In fact, the best designers use nature's pattern book for ideas. A design copied exactly from nature is called *naturalistic*. Sometimes it is necessary to place a design of flowers in a small space and to use it as a unit in part or as a whole. In order to modify the shape of the flower to fill the space, sometimes only the general form is used, and the design is then called *conventional* and not naturalistic.

Carpet designs should consist of small patterns, conventional flowers, animals not drawn in perspective but drawn in form of a projection so as to lie flat and appear inconspicuous, unless the carpet is intended for use in rooms in which there is very little furniture. In that case, the floor covering may be conspicuous, with large brilliant floral designs.

Color. Color is very important in textile designing. It gives life to a pattern. Since color impresses people differently, it is only natural that we should have designs in many different color combinations. The chief purpose in coloring cloth is to beautify the fabric and make it more pleasing to the eye. It is true that dyeing improves the " feel " of the cloth, but the primary purpose is to give a pleasing effect by the aid of color.

CONVENTIONAL DESIGN

NATURALISTIC DESIGN

Therefore the designer must harmonize the color scheme of decorations with the weave structure of the fabric. (See page 105.)

Simple Design. The primitive decorations used in textiles were lines — either vertical or horizontal forms repeated, giving us stripes, cords, checks, etc. Vertical lines give an elongated effect. The next simple design for ornamentation was the circle, which may represent a cross-section of the stalk of a plant such as a reed, and is used in printed fabrics. Developed from this

design, and commonly found in southern countries, v have scrolls and spirals. The square gives us chec and zigzag lines. The blooming flower has furnishe much artistic inspiration. The tapering stem ar spreading petals with graceful curves offer a contra to the upright pistils.

Oriental Designs. In studying the progress of ma kind, which is history, it is customary to arrange even in certain periods. This does not mean that there a any sharp dividing lines which separate one peri from another, because the course of history is co tinuous. We can, however, divide history into perio of civilization — that is, the growth and developme of certain races and people. We may distinguish thr great types of civilization, namely, the oriental, t classical, and the Germanic. The earliest civilizati was developed by the oriental nations, and was furth developed by the classical nations of Greece and Rom whose culture was afterward transmitted to the Germa people.

The oriental world gave us the beginnings of civiliz life and the earliest types of art. These appear in th architecture and in the decoration of their homes a palaces. The art of early nations was blended by mea of conquest. For example, the conquest of Egypt Assyria did not destroy the Egyptian art and cultu but brought the two together. The Persians by mea of conquest and commerce brought together a co posite art and culture which we may truly character as oriental. The principal oriental designs may

divided into the Chinese, Japanese, Egyptian, Indian, Persian, and Arabic.

Chinese Designs. In China, famous for textiles from a remote period, it has been said that fine silks were made 3000 years B.C. The designs and colorings, although peculiar, were usually of great richness; among these the dragon, the imperial emblem of China, was often found in various forms in the early patterns. Many of the modern designs contain symbolical figures, — birds, dragons, butterflies, flying fish, bamboo blossoms, and cloud forms being introduced in a naturalistic way, often with a meaning or symbolic message. A decorative fabric in China means something more than a mere fabric. It carries a message. The flowers are more naturalistic than in other oriental types of design, such as the Persian and Saracen.

CHINESE DRAGON

Japanese Designs. Some of the characteristic features in Japanese design are similar to those of the Chinese, owing no doubt to the active commercial intercourse and exchange of ideas which have been kept up between the two countries for ages. The Japanese style in designs for weaving and embroidery is generally more regular, follows a closer observation of nature, and is more often original in treatment than the Chinese. Many Japanese designs were printed by means of a stencil cut in vellum. This was placed upon the fabric and the colors were forced through the cut parts with

a brush. Japanese stencil designs on silk are remarkable for their workmanship, color, and fine detail.

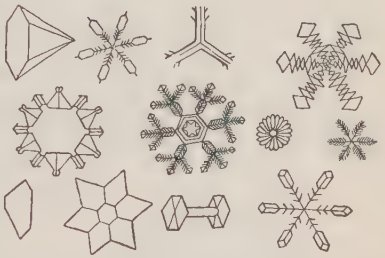
Egyptian Designs. Egypt was one of the earliest countries to produce textile designs. Some of the earliest figured fabrics in existence have been found in Egyptian tombs belonging to the 5th and 6th centuries B.C. Their designs are similar to the early patterns of the Peruvian and South American tapestry weaving. (See page 597.)

Many of the fabrics show a simple example of Egyptian pattern weaving (linen), indicating that the Egyptians rarely covered a fabric with ornament; their patterned robes were chiefly of plain cloth, with bands, borders, panels, and medallions worked in tapestry and embroidery.

At the dawn of Christianity the Egyptian art became influenced by it and a new period developed through a combination of early Egyptian and Christian influences. This combination is called Coptic Art.

Indian Designs. The chief decorative fabrics of India were silk brocades or "kincobs" of Benares, embroidered muslins of Dacca, pile carpets of Malabar, rugs of Madras, and shawls of Cashmere. Cotton printing was an important native industry, especially in Lucknow, where the coloring and designs were considered equal to some of the English and French chintz patterns. Some of the best examples of India or Indo-Persian ornament are found on the printed calico "palampores" or bed covers. Indian fabric designs, although influenced at various times by Greek, Persian,

and Arabian patterns, had a distinctly ornamental style of their own, and showed a good variety of naturalistic and conventionalized patterns, including parrots, peacocks, lions, tigers, elephants; also the well-known Indian pine forms, which, no doubt, were derived from the Persian style. Indian textiles for centuries were unique in the excellence of their colors and dyes, beauty of materials, and perfection of manufacture, but in later years they have to some extent lost their distinctive character through the influence of European designs, the introduction of aniline dyes, and the cheaper forms of Indian goods that have been placed on the market.



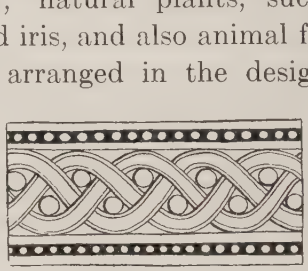
EAST INDIAN DESIGNS

Snowflake forms are frequently used in designs in Central Asia, particularly in rugs.

Some of the earliest examples of printing or staining on cloth were produced in India, and coming westward, reached Egypt, Asia Minor, and the Levant, but the art was not practiced in Europe until the 17th century. In the early days cloth printing was done in a primitive fashion. Engraved blocks of wood were daubed with a color pad, and the design struck on the cloth. The finer designs were formed on the wood blocks by suitably shaped pieces of metal. A separate block was required for each color in the pattern. Hand block printing is practised to-day in a manner similar to this.

Persian Design. Silk passed from Persia to Arabi where elaborate designs were made in symbols of th religious belief of the people. Persian designs usuall include large circular bands standing in vertical col umns, circles tied together, roses, and polygons. Th animal designs are stags, dogs, and winged horses i circles. Persian designs are clear and simple, giving a attractive decorative effect; natural plants, such a the rose, tulip, hyacinth, and iris, and also animal form were conventionalized and arranged in the design t

ACANTHUS LEAVES
Used by the Greeks.



SERPENTINE DESIGN
Used by the Greeks and Romans.

give combined harmony of color, beauty of form, detai mass, and spacing. This type of ornament largely in fluenced the designs of the 16th and 17th century Euro pean textile fabrics because of its easy adaptation t all kinds of woven material. Persia's most famou productions were carpets, although there were man fine examples of brocades, embroideries, velvets, an tapestries.

Classical Designs. The art and culture of th Eastern World were brought into Europe by means commerce. Greece, being the country nearest to Asi was the first to feel the influence of oriental art an develop a civilization of its own. The Greek peop

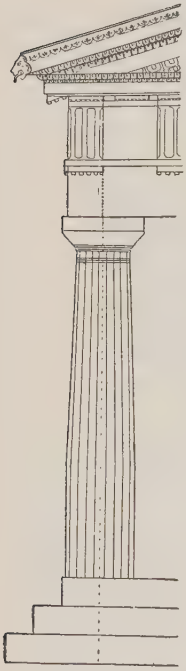
possessed certain characterisitics different from those of the Orient; they had a strong love of freedom, which made them independent, wideawake, and original. Moreover, they were characterized by simplicity and moderation, which were revealed not only in their art but in their lives, and which led them to shun all forms of oriental extravagance. Finally, they were gifted with a fine aesthetic sense, a taste for beauty for its own sake, which made them creators of a new form of art.

The art of Greece, like that of the Orient, was closely related to religion. Greek art was different from oriental art, since the Greek religion was different, as it appealed more strongly to human sympathy and revealed a finer sense of beauty. It produced an art which showed the marks of taste, reason, moderation, symmetry, and proper proportion. While some of the early features of Greek art were derived from the East, its distinctive character was due to the refined taste of the Greeks. It has simplicity of design, grace of form, symmetry of structure, and sincerity of expression. The Greeks developed the highest expression of art in the temple by means of columns and in textiles through tapestries, embroideries, etc. (See page 602.)

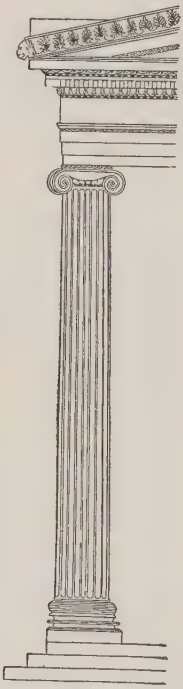
Since the Greek contributions to art appeared in the textile decorations during and after the Renaissance period, it is important to know the forms of Greek art — in particular the columns. Of these are three distinct types — Doric, Ionic, and Corinthian.

The earliest style was the *Doric*, which was the simplest and most dignified style. The column had no distinct base, and the capital consisted simply of a circular band surmounted by a

square slab. This style was used mostly during this early period, but it was always greatly admired by the Greeks. A later style was the *Ionic*, in which the column was more slender and rested upon a distinct base, and the capital was adorned with a spiral roll, or volute. A third style, developed still later, was called the



DORIC COLUMN



IONIC COLUMN

CORINTHIAN CAPITAL

COMPOSITE CAPITAL

Corinthian, which was a modification of the Ionic — the capital being somewhat more ornate and embellished with designs taken from the leaves of the acanthus plant. Small groups of figures representing mythological scenes were often placed above the columns. These artistic ideas all came from the flower, in which the column represents the stalk and the beautiful curves the parts of the flower. Various parts of the different columns have

been used as designs, such as the acanthus leaf from the Corinthian column, and the honeysuckle or pattern, sometimes called anthemion, from the Ionic column. The spiral scroll, called a volute from the Ionic is also noted. A combination of the volutes and scrolls with animal forms is very commonly seen. The right angle formation of straight lines noticed in the upper portion of the Doric column is called the fret and is generally used by the Chinese and others in textile designs.

The above are spoken of as ancient classic design motifs. During the 18th century the long buried ruins of Greece and Rome were excavated. As a result classic taste in design was stimulated and was strongly felt during the age of Louis XVI and in the Directoire and Georgian Periods.

The Romans were a very practical people and hence showed their art in buildings and developed the use of the arch. They obtained the refined features of art from the Greeks and may be considered the preservers of Greek art. The Romans often expressed their victories in tapestries, which they had learned to use as traders with the East.

While the Romans were originally pagans, toward the close of the fall of the Roman Empire, 476 A.D., Christianity made rapid progress. With the spread of Christianity through Rome and the provinces, it acquired a distinct culture of its own. Its architecture was borrowed from Rome. Then Rome was destroyed by tribes of Teutons (Germanic people) who settled in the countries represented to-day by Spain, France, Germany, Belgium, Holland, etc. The curves and motifs of the architecture were used by artists.

Byzantine Period. After the fourth century the Roman empire consisted of two parts; the western empire was centered in Rome, and the eastern empire was ruled from Constantinople. The western empire was captured in 476 A.D. by the Germanic tribes from

the north. The eastern empire, although threatened many times by the barbarians, remained a leading European power for many hundred years. Its highest degree of prosperity was reached between the ninth and eleventh centuries. Many of the emperors were great builders, and they developed a form of art called *Byzantine*. It was really a combination of oriental (Saracenic and Arabic) motifs with Christian motifs, due to the Christianization of Constantinople in the fourth century. The principal motifs were Moorish scrolls and lattices, Christian crosses, and other symbols, Romanesque colorings, and Saracenic gold. The artists excelled in embroidery, woven silks, etc. The church architecture was very important and its striking feature was the dome, which replaced the flat roof commonly used in Italy.

German Influence. The period from the fall of Rome, 476 A.D., to the end of the tenth century is often called the Dark Ages and was a period of decline in art and civilization. The masterpieces of art were neglected because the Teutonic invaders were indifferent to them. But as time went on, the posterity of the invaders showed a fine capacity for growth and achievement in art, and their work differed from that of the classical and Byzantine period because of the Germanic influence.

The development of the guilds made the cities of the Middle Ages, along with the monasteries and cathedrals, the home of art in textiles, architecture, sculpture, and painting. The outgrowth of their religious faith led the

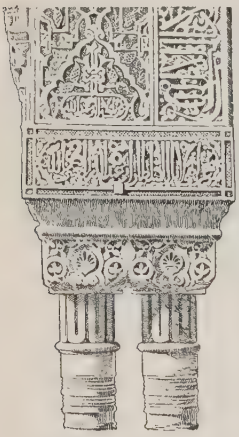
people to develop art and to give expression in the form of art to their religious enthusism. The style of architecture from the ninth to the middle of the twelfth century was characterized by the round arch and dome and was called *Romanesque*. Toward the close of the twelfth century Romanesque architecture was superseded by the pointed arch, broad, beautiful windows, slender spires, and rich ornamentation, and was called *Gothic*. The pointed arch was developed in northern France, but the idea was received from the Arabians, who used it in the construction of their mosques. All these artistic motifs influenced the designs of textiles.

GOTHIC ARCHITECTURE — CANTERBURY CATHEDRAL

Influence of Architecture on Textile Design. The design in architecture of any period is closely correlated

with the fabric design of that period. This is due to the fact that originally famous artists were also craftsmen — as Raphael, etc. The Gothic period has an architectural feeling of verticality which is reflected in hangings and tapestries. Scenes from stained glass windows are often placed on Venetian satin velvets. During the seventeenth century many patterns for damasks, brocades, velvets, and tapestries were sculptural in style. The same applied to other periods when fabrics were produced closely related to the style of architecture of that period.

Arabian Designs. The Arabians were originally a people of the desert, and lived either in tents or houses. The desire to make their tents and homes attractive led to many notable achievements in decorative textiles. Doors and openings had hangings of decorative draperies, and they made rugs and carpets to sit upon. The walls of their tents also were covered with tapestries. The Arabians' mode of life afforded considerable leisure, and they found opportunities to express their ideas of art in beautiful textiles and fabrics. The scenes and colorings were taken from their religious beliefs. They had a series of unbroken conquests, including Persia, Syria, Egypt, North Africa, Constantinople, and Spain. Very soon vast hordes of Arabian colonists arrived in these



ARABESQUES FROM THE ALHAMBRA

countries and they became centers of Arabic art and civilization. They developed a very striking style of architecture which is called *Byzantine*. The Arabians also developed a beautiful style of ornamentation called *Arabesque*, which is made up of lines and curves. They were not original, but borrowed from the East and transmitted their ideas to the people of Western Europe.

Saracenic Designs. Successive conquests placed the Egyptians under the rule of the Persians, the Greeks, the Romans, and the Saracens. These changes influenced fabrics and designs, and the result can be traced in the pattern and workmanship of Christian Coptic, Saracenic, and Byzantine materials.

Embroidery was one of the earliest methods of decorating fabrics. The Copts, who were the Christian descendants of the Egyptians, were very skilful in making embroidered garments, etc. The round patches of design were sewed on to the front or back of the garment, similar to the Chinese method of to-day. Many of the Byzantine woven fabrics from the 10th to 12th century were of silk, the designs often containing animal forms facing each other within enclosed circular spaces; most of these fabrics were produced at Alexandria and Antioch.

The early fabric designs of the East showed several developments of the Mahometan style, which varied in different countries. In Persia it was known as the Persian style; in Syria and Egypt, as Saracenic or Arabian style; in Tunis, Morocco, and Spain, as Moorish or Moresque; in Turkey, as Ottoman; and in India,

as Indian style; each of the countries showing some characteristic feature of its own in the designs.

Spanish Fabric Designs were composed chiefly of pure Arabian geometric styles, with interlaced ornaments without floral patterns. Many of these patterns, copied from the Alhambra in Spain, showed beautiful arrangement of form and detail, and were sometimes named Moresque or Spanish. Some of the common decorative fabrics were silk damask, Spanish 15th century geometric interlacing pattern, embroidered with a lace chain stitch; woolen velvet, Spanish 16th century, showing the flat treatment of pattern adopted in Arabian designs; satin damask fabric, Moresque 14th century, with figures arranged similar to the early Byzantine fabric patterns.

Italian Fabrics. In the 12th century many weavers and embroiderers were taken from Greece to Palermo, Sicily, and to South Italy, where they produced in these places many beautiful woven textures. The industry was carried on from the 12th to the 16th centuries, which comprised the best periods. The style of design is described by various names as Saraceno, Sicilo-Saracenic, Sicilian, and Lalermitan. Other great centers for textiles were in North Italy. The best specimens of manufacture and design came chiefly from Florence, where rich silk brocades and velvets were produced from the 15th to the 17th century; from Venice, famous for silks, damasks, and velvets, from the 15th and 16th century; and from Lucca, probably the first center of textile weaving, many of the designs being similar to the

Sicilian. Genoa productions were influenced more by the French designs, as this city was near France. The chief features of these designs were the vine, pomegranate, and pineapple; later other fruit forms were introduced through trading with the East. (See page 594.)

Renaissance Period. Renaissance is a term used to denote a period of art which sprung up in Italy toward the end of the Middle Ages. This movement took place in the Italian cities like Florence, which became centers of culture due to the revival of love of Greek and Roman art. This artistic revival was a return of art to nature, while mediaeval art lacked freedom and naturalness. The characteristic art of the Renaissance was painting and textiles. The renaissance motif of art from which all drew their inspiration was different for each country. It differed according to the temperament of the people. So we have Italian, French, German, Spanish, English and Flemish renaissance, modified according to local conditions.

French Art. France is famous for silk weaving, which was first established at Lyons, about the middle of the 16th century. The early design and textures were similar to the Italian patterns, but the later ones, up to about the 18th century, became more floral in character, and showed realistic renderings of flowers and foliage. The designs of to-day are chiefly naturalistic, and often contain large ranges of colors.

Louis XIV Period. France, after the Renaissance, made a definite move to become the art center of the world. Kings, queens, and nobility were interested

in developing artistic products, particularly in textiles. The first great patron of textile art after the Renaissance was Louis XIV. He fostered a large number of establishments devoted to fine fabrics, such as the

PRINTED DESIGN

After a painting by Watteau. Note the country scenes.

Gobelin tapestry work, and encouraged all to patronize the skilled weavers. (See pages 597, 598.) While the characteristic motif of the Renaissance period was the repetition of acanthus leaves and vases, the age of Louis XIV made a refinement of these with scroll motifs in a masculine spirit (serious and classic).

Louis XV Period. Louis XV continued the policy

of encouraging decorative fabrics, and designs were of a very high character, similar to those of Louis XIV, with the addition of more curvilinear and small patterns. Designs were made by the artist Watteau and others depicting scenes of gaiety and extravagance, with cascades, pagodas, etc. The last motifs were due to a movement to open up trade relations with China. A French commissioner had been sent to China and was cordially received, and Chinese styles, that is, a naturalistic treatment of floral life, plant forms, dragons, etc., became fashionable. The designs were made on ribbons and lace. The Louis XV period made much use of such forms as pastoral scenes, natural flowers, laces, and wall panels of tapestry for decoration. Madame de Pompadour introduced during this period the vogue of small floral designs. Watteau designs are the motifs used by the artist Watteau during the age of Louis XV to depict pastoral scenes. Many of these are very beautiful.

Jouy Designs. These were designs made from Jouy printed fabrics, which were originally cotton printed in imitation of various imported oriental goods executed at Jouy, in the valley of the Bievre, in France, by Oberkaupf. Later, by analogy, a large variety of other printed cottons made to imitate the real Jouy canvas were also called by that name. In 1759, Oberkaupf opened his establishment at Jouy as the result of a royal brevet. Before his time the printing process on cottons in France and in other countries consisted in marking the outline of the design in black and filling it

in with colors by hand. He introduced machine printing by means of blocks and rollers in all colors. He soon achieved great success both in France and abroad. Jouy canvas became the rage, both for dresses and interior decoration.

Louis XVI Period. During this time a strong movement took place for the revival of classical motifs in simplicity of line, with the addition of dainty miniature floral designs. This was due to the influence of the queen, Marie Antoinette. She set the standard for both decorative and dress fabrics. To illustrate, draperies were originally used for utilitarian purposes only, such as portières. She influenced the nobility to use draperies primarily for decorative purposes. This artistic movement spread throughout the country and decorative fabrics began to harmonize with the room in which they were used. This continued until the time of the French Revolution, when all art was abandoned for a time.

Directoire Period. This was the style followed after Louis XVI, from 1793 to 1800. During this time, the arts of France languished. Any design suggestive of nobility was considered improper. So a definite style was adopted, an adaptation of the classic period, dainty and delicate designs after the Italian Renaissance of the 15th century.

Empire Period. This was the style adopted during the reign of Napoleon I. It was really a continuation of the Roman, Egyptian, and Grecian war periods, and emphasized heroic acts, decorations, and conquests.

Egyptian designs have been used during the Empire period (following Napoleon's Egyptian Conquest) and during 1923 when important excavations of Egyptian tombs took place.

The other period decorations used frequently among textiles are the *Jardinière*: designs during this period consisted of flowers, fruits, and other garden effects in suitable colors; the *Jouy* period, which showed small flowers edged with black.

Flemish Design. The people who settled in the country now called Belgium, between France and Holland, have contributed a great deal to textile design. Unfortunately, owing to political conditions, the Flemish people have not enjoyed full credit for their achievements in beautiful decorative textiles. They have excelled in artistic ability in velvets, tapestries, carpets, rugs, laces, etc. (See pages 614, 616, 617.)

Peruvian Designs. The early settlers of South America, especially the Peruvians, showed considerable taste in textiles. Their fabrics are very artistic and use every trick of the weavers' art. Indeed, in some of the color combinations they far surpass modern work. Vicuna wool, which is finer than alpaca and very silk-like, is used. In addition to the fine cotton and wool cloth, there are blankets, embroideries, so-called "double weaving," and tapestry. In tapestry, Peruvian artistry reached its highest development, placing this kind of textile in a class by itself, making the Gobelin and even the Chinese silk tapestry appear coarse and heavy in comparison. Some of the finest

pieces of their handiwork contain nearly 300 weft yarns to the inch, and their cleverness in adapting most intricate designs and overcoming the technical difficulties of their crude looms is something that has never been accomplished by any other people, except perhaps by the makers of Coptic fabrics in Egypt, dating from the first centuries of the Christian era. In many ways, the likeness is indeed remarkable between these two ancient lands, half a world apart. Like most historic peoples, the Peruvians made use in their designing of the objects which were familiar to them in their daily life. First are the realistic forms; then, little by little through repetition and elimination, they arrived at a conventionalized or geometric figure, which is far removed from its original source of inspiration. Notwithstanding the enormous variety of designs in these quaint animal, human, and geometric forms, there are in reality only four or five prime subjects used: the man, the fish, the bird, the puma or cat, and hieroglyph-like figures, these recurring singly or jointly, in every conceivable combination. The greatest care and skill were expended upon the human figure as a motif, and upon the mythological characters. The designs in these must be seen in order that the wonderful variety of color and symbolism they portray may be appreciated.

Georgian Period. The years 1714 to 1820 mark the duration of the period when Georgian design came, flourished and passed on. In this stretch of years a great many artists and architects created the beautiful things which have made each one well known to us for

his individuality and own peculiar charm. Georgian design was a development from the Italian style in the direction of adaptation to English requirements. Much of the distinctive Italian quality was lost in this absorption but a great deal was gained in freedom and picturesqueness of detail. Georgian design was an important source of inspiration for the designers of our American colonial period. Designs of this type were recognized by their architectural features, beautified and enriched by, the use of flowers, fruits, birds, etc. While expressing formality to a certain degree, the furniture and hangings of the Georgian period combined to make more comfortable and livable rooms than those of contemporary France.

Pepper-and-Salt. In textile designing, a term used to denote a color effect, consisting either of a light ground (as white, drab, or grey) finely dotted or flecked with a dark color, as black or dark grey; or, of a black or dark grey ground thickly and evenly specked with white or light grey. The term is especially applicable to fabrics and garments of wool.

Polka Dot. In textile designing, a name used to denote a pattern of large round dots or spots sparsely scattered over the surface of the fabric. The pattern may be produced by any of the prevailing methods of ornamentation: as, by weaving, printing, embossing, embroidering, etc.

Pompadour. In textile designing, a name used to denote small flowered designs printed or brocaded in bright colors; pink and blue are always intermingled

in the pattern, and these are frequently heightened with vivid yellow. Pompadour effects are confined chiefly to silk and cotton fabrics. The pompadour parasol is a style of sunshade having a folding handle, and usually covered with moire antique or other heavy silk.

Methods of Decorating Textile Fabrics. Along with the history of period textile decorations we must consider the methods of decoration. The earliest forms consisted of printed, embroidered (see page 464), woven fabrics (see page 83), braiding (see page 471), and laces (see page 450). The first designs were painted on muslins. All the designs were ingenious, full of meaning, graceful, and harmonious. The people of Egypt, Persia, and China used embroidery on vestments to denote the rank or station of the individual. The Chinese used silk and the other nations used cotton and linens. The first French prints were painted along similar lines and adopted by the Persians and Indians.

There were three methods for decorating the surface of cotton fabrics in the 16th century: the resist method, painting, and embroidering. The resist method consisted of placing blocks, cut in definite designs, on the fabric and pouring dye liquid over the fabric. The blocks were held down by weights so that none of the dye liquor could penetrate the portion of the fabric under the block. Another resist method was knot tying. The fabric was bunched into knots, which were tied tightly with a thread and then immersed into dye

solutions of different strengths. This form of dyeing is done by hand labor and can only be carried on in countries where labor is cheap. The following are the directions for knot tie dyeing:

(1) The fabric is folded many times until it is reduced to a rectangle or square about $1 \times 1\frac{1}{2}$ feet, and several folds in thickness. (2) It is dampened and pressed over a block with pins erected in the form of the design. (3) It is then removed from the raised pins and the portions over the pins are tied in a knot in a crinkled manner. (4) The fabric is then dyed in the lightest shade first. (5) It is put through the same operations for a new design and then dyed.

Batik Method. Another favorite method of resist dyeing, originally used by the natives of Dutch East Indies is called Batik dyeing. Upon a piece of linen various designs are outlined with a pencil, and when the design is completed the parts that have been ornamented are stiffened with liquid preparation. The unornamented parts are then dyed the desired color. After ornamentation and dyeing, the entire fabric is boiled in water so as to wash out the hardened liquid. The dyed parts retain the dye and the formerly stiffened parts remain the color of the original fabric. This method is also adapted to use on velvet, silk, and leather. The Dutch introduced its use in Europe, whence it came to the United States.

Braiding. Many narrow fabrics, used for tying and ornamentation, cannot be woven on a loom, and for the production of these the process of braiding was used long before the braiding machine was invented. In the Middle Ages the maids and matrons of European

countries knew how to turn and twist silken threads to make a braid for use as an ornament on a lady's garment or a soldier's armor, or for the girth of his battle sword. In every museum many beautiful pieces of *hand braiding* can be seen, which demonstrate the skill of our ancestors in this direction. It was not until the middle of the last century that the braiding machine was invented.

Embroideries. Embroideries and the art of embroidering are classed among the earliest accomplishments of civilized peoples. From time immemorial Egypt, Persia, Turkey, India, in fact, all the countries of the Orient, rivalled each other in fostering the art. As civilization extended westward, it was transplanted into Europe, where embroidering in all its branches was developed to an extraordinary degree of excellence. Among the Greeks the art attained a high perfection, so that the influence of their work remained through after ages and affected all subsequent styles.

According to what principles the art of embroidery has developed we can only conjecture. The process has probably been to advance from simple to complex lines; then to geometrical patterns, flowers, and foliage; next, to figure ornaments taken from the animal world, until at last a culminating point was reached in the employment of figure motives, portraits, and rich scenery. Few people of the present day have a just idea of the labor, the expense, and the length of time often bestowed upon old embroideries. In the larger pieces or hangings intended for churches and great houses, the design first had to be carefully sketched upon the cloth by an artist and then filled out with the vari-colored threads by skilled artisans, requiring sometimes many years to complete a single piece. From the 9th to the 15th century was a glorious period for needlework in Europe, especially in France and England. Spinning and embroidering with crewels and silk became the daily occupation of women of all ranks, from the palace to the cloister. The work at first was confined principally to

ornamenting church vestments, altar cloths, coverings for sacred books and garments for priests, bishops, etc. At the close of the 14th century, the art of pictorial needlework, or embroidery, had spread throughout all Europe. At this time embroidery as a fine art surpassed painting in many respects. The needle, in the hands of a skilled artisan, moved over the woven tissue like the brush of the painter, leaving behind the colored threads and producing a picture as soft in tone and ingenious in execution as the painter could produce with his oils. Both men and women pursued the art as a trade, and great ladies wrought in their castles surrounded by their maidens. Embroidery was the latter's chief pleasure and most serious occupation. Shut out from business life, they had ample leisure to cultivate their taste and ample means of gratifying it.

Embroidery has been extensively used in all ages for decorating hangings and vestments for the church, and similar purposes, but its use in ordinary dress was not customary in Europe until during the Middle Ages, when garments richly ornamented with embroidery were worn by all classes of people who could afford them. During the reign of Elizabeth of England no court dress or fine clothing of any character, whether for man or woman, was complete without it. The work at this time was all handmade and very expensive, consequently only persons of wealth could afford the luxury of wearing it. The general use and popularity of embroideries among the masses was reserved for a recent period in this century, and only after the invention of the embroidery machine.

From an industrial point of view, embroidery may be ranged in two classes. First, white embroidery, worked upon cloth — muslin, cambric, swiss, tulle, etc. — and applied to dress and furniture. This class is usually made in the flat-stitch style and is for the most part machine work. In its production Switzerland holds first place, and then France, Germany, and Scotland. The second class comprises embroideries worked in silk and in gold and silver threads. Those made of the precious metals are more especially adapted to church ornaments and military costume. From the Orient are obtained the most elaborate specimens. In the production of wholly hand-wrought silk embroidery and embroidered

articles, the Chinese and Japanese are the most expert nations. These deft workers embroider both sides of the fabric exactly alike, so that it is impossible to detect a difference or to say which is the neater. The Japanese borrowed the art from China, and at present their taste and skill are universally recognized, although China was the original exporter of this class of goods to Europe and America.

Swiss Embroidery. In both Europe and America during the first half of the 19th century, ladies of every rank and station found an agreeable occupation in embroidering on strips of muslin patterns which had been previously stamped thereon in blue outline. So great did the demand become for this class of washable trimming, that thousands of women in Ireland and Switzerland were employed by Belfast and Glasgow merchants in producing it. The technical skill and taste of the Swiss needle-women were marvelous, and gradually the exquisite embroidery made by them became famous all over the world. In almost every village throughout eastern Switzerland (particularly in the cantons of Appenzall, Thurgan, and St. Gall) agents were employed giving out stamped strips of cambric, and receiving them back nicely decorated. Prior to 1828 all the beautiful work was done by hand, and in the people's homes; but the invention of a machine to do the work rapidly changed the whole situation. By the aid of the new invention it was possible for two persons to do the work of a dozen or more working with single needles. At present possibly not over 5 per cent of wash embroideries are made by hand, and those only special articles that are fine and expensive.

Lace. Lace, like porcelain, stained glass, and other artistic things, has always been an object of interest to all classes. Special patterns of laces date from the 16th century. The church and court have always encouraged its production. While the early lace work was similar to weaving, in that the patterns were stiff and geometrical, sometimes the patterns were cut out of linen or separately sewed and applied to the meshed surface, but more frequently they were darned in, the stitches being counted in, as in tapestry. This kind was known as darned netting. With the development of the renaissance of art, free flowing patterns and figure subjects were introduced and worked in.

The lace industry first took root in Flanders and Venice, where it became an important branch of industry. Active intercourse was maintained between the two countries, so that intense rivalry existed. France and England were not behind Venice and Flanders in making lace. The king of France, Henry III, encouraged lace work by appointing a Venetian to be pattern maker for varieties of linen needlework and lace for his court. Later, official aid and patronage were given to this art by Louis V. Through the influence of these two men the demand for lace was increased to such an extent that it became very popular.

Under the impulse of fashion and luxury, lace has received the stamp of the special style of each country. Italy furnishes its Point de Venice; Belgium its Brussels and Mechlin; France its Valenciennes, etc.

Very little is known of the early lace manufacturers of Holland. The laces of Holland were overshadowed by the richer products of their Flemish neighbors. The Dutch, however, had one advantage over other nations in their Haarlem thread, once considered the best thread in the world for lace.

In Switzerland, the center of the lace trade, the work was carried on to such a degree of perfection as to rival the laces of Flanders, not alone in beauty, but also in quality.

Attempts have been made at various times, both during this century and the last, to assist the peasantry of Ireland by instruction in lace-making. The finest patterns of old lace were procured, and the Irish girls showed great skill in copying them. Later a better style of work, needlepoint, was modeled after old Venetian lace — the exquisite productions for which Americans pay fabulous prices at the present day.

The lace manufacturers of Europe experienced a serious setback in 1818 when bobinet was first made in France. Fashion, always fleeting, adopted the new material. Manufacturers were forced to lower prices, but happily a new channel for export was opened in the United States.

Machine-made Designs. In the middle of the 18th century, all the textile arts were being carried on in practically the same way that was followed six or seven thousand years before in Egypt, by slow hand operations, where the qualities of designer

and craftsman were usually combined in one individual, who usually manufactured, dyed, printed, and decorated his own goods, and sometimes had also to find a market for that which he produced, — all of which was expensive and made the cost of the fabric prohibitive except for the wealthy. All this was suddenly changed by a few inventions which brought about specialized labor and large units of industry and quicker methods of production, which placed on the market decorative fabrics that were produced cheaply, and in great variety, to serve the consumer.

QUESTIONS

1. What is the purpose of decoration with textiles?
2. Explain why each civilization and country has distinctive styles of decorations.
3. (*a*) What are the principles of a good design?
   (*b*) What is perspective?
4. Give the history of textile design in its three large divisions according to civilization.
5. Describe briefly the characteristic textile designing of the following countries. Egypt; China; Japan; Arabia; India.
6. What were the chief contributions made by the Greeks and Romans to art — especially to textile designing?
7. (*a*) What textile designs were furnished by the Eastern Roman Empire? (Constantinople.)
   (*b*) What is this period called?
8. (*a*) What is meant by a Moorish design?
   (*b*) How have the Moors contributed to textile design?
9. What effect has Christianity had on the art of textile design?
10. (*a*) What is meant by the term "guild"?
    (*b*) Have the guilds contributed to textile design?
11. (*a*) What is meant by the term "Renaissance"?
    (*b*) How is this period linked with art?
12. Describe the meaning of the following; Italian Renaissance; Flemish Renaissance; French Renaissance.

13. Describe the following periods: Directoire; Restoration; Empire; Pompadour.

14. Describe the three great divisions of textile designs as found in the early ages.

15. Describe briefly the nations that have contributed to textile designing.

16. How much have the Flemish people contributed to textile designing?

CHAPTER XXX

UPHOLSTERY OR DECORATIVE FABRICS

Decorative fabrics, sometimes called upholstery fabrics, include cretonnes, chintz, art denim, cotton plush, corduroy, rep, chenille cloth, silk damask, tapestry, plush, velvet, velour, netting, scrim, lace, sateen, and brocatelle artistically arranged for hangings, curtains, cushions, furniture coverings, etc.

Heavy Fabrics. Generally speaking, the heavier fabrics, such as damask, velour, tapestry, rep, chenille, art denim, ticking, cotton plush, etc., are used in the form of curtains or portières for doors and archways, while the lighter fabrics, including silk, satin, silkaline, chintz, cotton crêpe, and tapestry prints are used for window draperies, furniture decorations, pillows, cushions, and small furnishing.

Festoon. Festoon drapery is the name applied to a form of ready-made curtain for windows and archways, composed ordinarily of damask and fringe, and attached by draping in graceful folds over a pole.

Brocade. (Derived from Spanish *brocado*, brocade, through *broca*, signifying the reel on which embroiderers wind their thread; French *brocher*, embroider, stitch, etc.) A fabric of silk, cotton, or wool, the ornamental pattern of which is made to appear in slight relief,

produced by raising the threads of the warp or of the weft in the loom. The term brocade is applied chiefly and properly to silk or silk-mixed fabrics, particularly to such as are ornamented with large, rich figures of the floral type.

Until the invention of the Jacquard attachment to the loom in 1801, embroidered silk goods were called brocades. After that date a distinction arose between silks figured in the loom and those which were embroidered after being woven. Thenceforward, embroideries came to be classed by themselves, and figured silks woven by the Jacquard attachment were designated brocades. This distinction is observed in all countries, particularly with reference to silk tissues. In the United States, however, the term is often used to denote a loom-figured fabric composed of cotton or wool, or of their intermixture.

Brocade (in its original meaning and signification) represents one of the richest and most ancient fabrics of which we have any record, its production forming what is probably the oldest branch of the silk industry of China and Japan. In the latter country the most notable specimens include two varieties: those wrought with gold and silver threads, and those of heavy silk ornamented with flowered patterns in embroidery. In Europe the earliest brocades were stuffs composed of gold and silver threads. These metallic tissues were sometimes made with a foundation of felt, richly embroidered with threads of silk and precious metals; and again, of flat ribbons of gold and silver inwrought. As the production of silk increased in Europe, the use of gold and silver for textile purposes declined, until in time metallic threads ceased to be employed altogether; the word brocade, however, continued to be used to designate all-silk fabrics ornamented with flowers and other raised patterns in embroidery up to the date of the introduction of the French loom attachment previously referred to.

Brocatel (*brock-a-tel*). (From French *brocatelle*, imitation brocade.) A coarse, stout variety of brocade,

woven either of silk or of cotton or of an intermixture. The designs are usually large and of a bold and vigorous character. When made of all cotton, the fabric is finished with a more or less silky surface. A distinguishing feature of brocatel is its raised figures, which are made to appear puffed out into slight relief above the ground. When made of all silk, the facing of the figures is of a satin weave, and it is usual to have very little ground, in order that full advantage may be taken of the rich effect which this satin gives. Brocatel is used chiefly for curtains, furniture covering, tapestry, and lining for carriages. During the 16th and 17th centuries brocatels were probably more in evidence than at any other time in their history. The appearance of tooled leather or carved woodwork which characterizes this unique fabric made it especially appropriate to combine with other decorations used in the interiors of that time. To-day brocatels are being selected by decorators for a variety of purposes. The raised — seemingly embossed — designs when used for wall coverings or draperies give a decorative effect which is difficult to obtain with other fabrics. Brocatels are suitable for furniture coverings as well. Technically brocatels differ from damasks in that they are made with two or more fillings — one of linen, which gives the raised effect. There are also two warps, the second acting as a binder to hold in place the filling which makes the ground.

Damask. Look at the elaborate design on a fine tablecloth of a damask fabric; note the fineness and

beautiful effects of weaving. Woven designs of this type have long been used for decorations.

Damask was originally the name used to designate a particular style of twill and was applied to several kinds of twill woven fabrics. It is elaborately woven in colors, and sometimes in gold and silver threads. Damask is so called on account of the perfection at one time attained by the silk weavers of the city of Damascus in Syria. China, beyond doubt, was the first country to ornament silken fabrics with a pattern. India, Persia, Syria, and then Greece followed in China's footsteps. These richly figured stuffs brought with them to Western Europe the name of " diaper," which it is said was bestowed upon them at Constantinople. During the 12th century the city of Damascus, even then long celebrated for its looms, so far outstripped all other places for beauty of design that her silken fabrics were in demand everywhere. And thus, as often happens, traders fastened the name " damask " upon every richly wrought silk fabric, regardless of whether it came from Damascus or not. Real damask is properly a silken fabric, but since the 16th century the term has been indiscriminately applied to any material woven after the manner of the first damask.

At present damask, in its broadest application, denotes a twilled linen or silken fabric richly figured in the loom with patterns of a large and dignified type of flowers, leaves, fruits, or ornamental scrolls. Damask being a matter of weave rather than of any particular fiber, may be produced in various materials, — linen, silk, and bright wools, however, being the most effective. A true damask is one in which the ground and the pattern are worked out in satin weaves, for luster and the contrast which is necessary in order to bring out the effect of the pattern is obtained by throwing the warp and weft to the surface at right angles. In this way, the play of light upon the fabric distinguishes the pattern from the ground. According to the angle from which the fabric is seen the pattern will be lustrous, or the ground will have the silk-like effect. True damask has an eight-shaft satin weave in both ground and figure. Frequently the term is used to describe fabrics in which only the ground is satin, while the pattern

is brought out by some weave effect: by a two-leaf or three-leaf twill; or, as in silk damask, by the use of different colors. In the case of the twill, the comparative dullness contrasts with the luster of the satin ground. As a rule, the charm of a damask is retained most successfully by adopting a large and dignified class of ornament, rather than by a light and dainty pattern.

Cretonne. A heavy cotton cloth printed in large designs, for drapery and furniture use. Cretonne was a Frenchman who first made the cloth. The fabric usually runs from 2 to 5 ounces per yard and is composed of yarns from 1/40's to 1/20's in the warp and 1/20's to 1/7's in the filling. The construction is about 52x40, and the width runs from 25 to 36 inches, the narrow grades being the lightest in weight. The cloth is usually a plain weave, although sometimes it is woven as a twill or satin to increase the decorative effect. It may be printed in the whole or grey cloth. The whole background shows the colors to better advantage, although the grey will not " stain " or show the dust as quickly as the whole.

Cretonne represents a type of printed cotton or linen fabric that has become very popular as a decorative material. Originally only the wealthy were able to purchase textiles for home decorations. To-day, as the result of the application of art to textile manufacture, it has become possible to make printed fabrics in beautiful colors so cheap that it is within the reach of all to purchase cretonnes and other printed goods for curtains and furniture coverings.

A cretonne design usually consists of fancy stripes and allover floral pattern printed in bright colors upon one side of the fabric. This gives the printed or face side of the cretonne somewhat the appearance of an elaborately figured Jacquard design.

The colors found most effective are bright and medium shades

of red, blue, green, yellow, and a jet black. The colors may be produced on the fabric by either roller printing or block printing. Sometimes, if we desire a dullness in the design, the warp is printed and then woven with a white filling. The effect of the white filling is to subdue the bright colors.

Cretonnes may be used for couch covers, draperies, lambrequins, comfortables, and bedspreads. The quality is governed by the following factors: composition; construction and weight; blocked in on the grey; the motif of the design; number of colors in the design; roller, block, or warp printing.

Cretonne may be either linen or cotton. Linen is stronger, has more luster, and shows the colors to better advantage. The higher the construction and weight, the more the fabric costs. The motif and number of colors also increase the price of the fabric. An elaborate design costs more to produce than a simple design. The number of colors above six usually costs a cent or more a yard additional for each extra color. Warp prints cost considerably more to produce than cloth prints; greater care must be exercised in the printing. The value of a warp print lies in the dullness of the shades. It gives a rich taffeta effect. A block print commands a higher price than a machine print, due to the craftsmanship and to the fine shades that can be produced by this method.

Stencil-Dyed Fabrics. Stencil dyeing is a method of decorating cloth which is, strictly speaking, neither stenciling nor dyeing, but rather a combination of the two. It is not in use in the domestic industry, and is in little use elsewhere outside of Japan. In the system used in Japan the design is first cut in a series of paper stencils, which are smeared with rice paste. A bolt of cloth is opened up and a stencil laid over the end of the cloth, which is then folded over and another stencil placed on it, and so on until the entire length has been folded back and forth, with stencils of the same pattern between each fold and exactly over one another. This bundle is placed in a hand press, and screwed down tightly; then indigo dye in liquid form is forced through the bundle from top to bottom by means of an air pump. As the cloth and stencils are closely compressed by the screw of the press, the dye goes through the cloth layers only where there are openings in the

stencils. When taken from the press and the stencils removed, the cloth is found impressed with a long series of patterns of the same design. Two or three colors are often used, the process being repeated for each color and applied through a different set of stencils.

Most of the stencil-dyed goods from Japan are in the form of articles such as table covers, runners, center pieces, napkins, and the like, or stencil-dyed goods in the piece. This cloth is called *tenuguiji* in Japan, and is often known as "Japanese toweling." The basic cloth is usually narrow hand-loom cloth, plain woven, in widths of 12 to 16 inches. It is usually stencil-dyed in indigo blue, but partly in two or three bright colors on a bleached ground, and put up in 10-yard bolts. The Japanese use these stencil-dyed cloths for various purposes, largely for hand towels; but American imports, largely a fad, are mainly used for draperies and other forms of household decoration.

Tapestries. Fabrics containing very pretty designs have been used for centuries to decorate walls and furniture and have been called *tapestries*. This fabric is made by interlacing on a warp colored threads of wool, cotton, or silk so as to produce a pattern. It is not exactly weaving or embroidery. The threads are not thrown with a shuttle as in weaving, but worked with short threads of various colors, which are put in with a needle. As many as 14,000 shades are available for working designs in tapestry. Hence the soft gradation of tones in the woven tapestry becomes one of its primary features and proclaims the quality of the work. In olden times it took weeks to interlace a few inches of a design, but today with modern methods it is possible to obtain tapestry which has scarcely felt the touch of the human hand, at a price within the reach of the average homemaker, and which may have all the beauty of the antique.

History. There is evidence of tapestry weaving all over the world. Signs of it are found in Egypt, North and South America, China, Greece, Borneo, Northern Europe, and Rome. The earliest evidence of tapestry weaving was found in Egypt. In the hypogeum at Beni-Hassan, dating about 3000 B.C., on a wall is a picture

DESIGN OF AN OLD FRENCH TAPESTRY

Marriage of Anne of Brittany

of a loom with two women in the act of weaving upon it. The loom is very simple, but has all of the essentials of the present day "high loom" used in tapestry weaving. In Babylon signs have been found which indicate that tapestry weaving was a common industry. In fact, it is commonly believed that a Persian king learned the art in Babylon and then taught it to his own people.

From Persia the art spread to ancient Greece. In the Greek

myths and in Homer's writings we read much of the art of tapestry weaving. Homer speaks of Helen of Troy weaving into tapestry the stories of the battles of the Trojan War. Ancient mythology contains ample proof that the art was common. From Greece the love for tapestry was carried to Rome. The Romans as traders gathered it from the East, and it soon became a household necessity in the Roman empire. It is not known whether the Romans carried the art to Northern Europe, or whether the Moors introduced it at their invasion. Nevertheless, at an early date tapestry weaving was carried on to a small degree in France and Germany. Later evidence indicates that it was carried on in monasteries in these countries. In 1025 there was a tapestry factory in Poitiers, France. In the twelfth century factories appeared in Arras, France, and in Brussels and Lille. In 1476 Giles Gobelin started a dye plant in France and later began to weave tapestries. This plant was later taken over by the French government. From France the industry spread to Holland, Belgium, and England, but the Gobelin tapestries of France have never been surpassed.

Gobelin Tapestry. There are about 400 Gobelin tapestries, of which 300 are of less distinguished quality, being of Flemish manufacture and made only for decorative purposes. The other hundred are of sixteenth century Gobelin and Burgundian manufacture. Many of these were made especially for the Hapsburg family and bear clearly the royal coat-of-arms.

The distinction of the Gobelin tapestries lies in the unique quality of the dyes used. Gobelin is the name of a family of dyers, originally from Rheims, who, beginning with Jehan Gobelin in the fifteenth century, became established in Paris in the Faubourg Saint Marcel. Jehan Gobelin discovered a scarlet dye-stuff which for richness and luster has never been equalled, and this dye-stuff he and his descendants used lavishly in tapestries of their own manufacture.

These tapestries were used by the nobility and royalty of Europe as floor and furniture coverings as well as for wall hangings and curtains, and in most of them some ancient or current heroic or religious episode was illustrated.

When the last of the Gobelins, in the seventeenth century,

ceased to pursue the art and craft of tapestry-weaving, the secret of their dye-stuffs was not passed on, so that their tapestries later became increasingly precious because of their rarity. That the Hapsburgs regarded them as of immense value is indicated by the fact that from the very first they chose to store these treasures rather than to use them.

For centuries the Hapsburg Gobelins have lain unrolled in the vaults of the Schönbrun palace outside Vienna. Many of them are of immense size, too large to be hung even in a palace. Each of them is part of a series. Some of the series contain six pieces, some eight, and some as many as twelve. Art authorities who have inspected these tapestries state they are in perfect condition.

These tapestries, rolled up and hidden in a palace vault, belonged to the Hapsburg family for generations until recently, when they were seized by the state. Few persons have seen them. Affection felt by the Austrian people for these treasures was expressed dramatically when popular opinion caused the Reparations Committee in 1919 to stop the project of selling the Gobelins in spite of the fact that almost every other resource for obtaining money for food and clothing had been exhausted.

Hand-woven and Machine Tapestries. Every buyer or seller of tapestry should know:

(1) How to distinguish hand-woven tapestries made on a high warp loom from those made on a low warp loom.

(2) How to distinguish the age of the tapestries.

(3) How to appreciate the technique of: (*a*) color, (*b*) weave, and (*c*) general design in relation to the value of piece.

(4) Machine-woven from hand-woven piece.

(5) Modern production from genuine antiques.

(6) Composition.

A hand-woven tapestry shows on the back all of the out-lines and differences of color of the pattern that appear on its face. The machine-woven tapestry, while showing all of the colors on the back, has no indication of the character of the pattern. Another almost certain characteristic that can be distinguished at a glance is the variation in the weave. Hand-woven tapestry is invariably perfectly true and straight, particularly at the edges.

To differentiate between wool and cotton and test for the presence of silk, requires a knowledge of the character of the different fibers.

Velvet. Silk velvet is produced in a wide range of weights, widths, and qualities, and used for a great number of purposes: for women's dresses and their trimming, millinery, men's coat collars, embroidery, etc. Inferior grades are woven with a cotton back, and are commonly known as cotton-backed velvet. All-cotton velvet is produced in immense quantities under the name of *velveteen*. These imitations and inferior grades are so common that real velvet is usually called silk velvet to distinguish it from them.

Velvet represents the original type of the numerous forms of pile fabrics. Of the country whence velvet first came, or the people who were earliest to hit upon the way of weaving it, nothing is known. In all probability the art of velvet weaving originated in Central Asia, perhaps in China. It is not until about the 14th century that any historical mention is made of this fabric, although fustian, which differs from velvet only in material, is mentioned as early as the beginning of the 13th century. The peculiar properties of velvet, the splendid yet softened depth of color exhibited, at once marked it as a fit material for ecclesiastical vestments, royal and state robes, and sumptuous hangings. Among the most splendid fabrics of medieval times were Italian velvets. These were in many ways most effectively treated for ornamentation, such as by varying the color of the pile, by producing pile of different lengths, by brocading with plain silk, with uncut pile, or with a ground of gold tissue.

The first velvet mill in America was erected in 1865, but the venture was unsuccessful. At present, however, there are a number of mills in active operation, brought into existence largely through favorable tariff legislation, which has enabled the domestic manufacturers to produce velvets at a profit.

Fine qualities of velvet are woven with from 40 to 60 loops per inch, hence the work is exceedingly slow and laborious. In width the ordinary grades range from 18 to 20 inches, though velvets intended for special purposes are often woven much wider. *Schappe* is the name given to velvet in which the pile is made of spun silk, to distinguish it from the ordinary variety made with a pile of organzine silk. *Embossed or figured velvet* is a superior variety ornamented with a pattern in relief; the usual type of design is large and bold, with clear and strongly marked outlines. The ground is commonly of a satin weave of contrasting color; also called *velvet broché* and brocaded velvet. *Ponson velvet* is the name given to various fine, heavy qualities used for making women's wraps. *Rubber velvet* is not a velvet fabric, but is so called from its fancied resemblance to such textures. It is made by sprinkling finely powdered flocks of various colors over rubber cloth while the latter is in a warm, soft condition. The product has the appearance of a fine felt, but is elastic, waterproof, and exceedingly light. *Stamped velvet*, or velveteen, is an inexpensive variety ornamented with patterns impressed by means of hot irons or embossing rollers applied to the face of the material under great pressure. The surface is more or less lowered from the pile according to the amount of pressure applied. In some cases, the ground of the pattern is brought to a smooth gloss. Stamped velvet is used chiefly for decorative fabrics.

Finishing. The finishing of all types of *plush* requires great experience and care, and involves numerous complicated brushing and steaming operations, all of which have for their ultimate object the production of an elastic, lustrous pile. *Seal plush* is a variety of mohair goods made in imitation of sealskin. It is one of the most expensive grades manufactured, and is used for women's winter cloaks and men's caps. What is known as sealskin plush, or silk seal plush, is also made in imitation of real seal fur; it is woven with a pile composed of wild tusser silk, the coarse, elastic character of which renders it peculiarly adapted for plush; it is used for caps, capes, cloaks, etc.; in width 24, 36, and 49 inches. *Crushed* and *embossed plush* are varieties of mohair goods, used chiefly for upholstery purposes. These effects are produced by means of heavy steel rollers, on the surface of which a pattern

is cut in relief. The rollers are first heated to a moderate degree and then made to revolve slowly while the dampened material is passed underneath. In this manner the pile is crushed flat in places, leaving other portions erect, to form the design. Furniture and upholstery plush are terms applied to both silk and mohair goods made of suitable weight and width for upholstering household furniture, car seats, etc.

Velveteen. A species of velvet woven entirely of cotton, commonly of greater width than silk velvet, and of heavier texture. The manufacture of velveteen in England dates from about the close of the 16th or the early part of the 17th century. Near the middle of the 18th century a great improvement in the mode of dressing, finishing, and dyeing velveteen was introduced by John Wilson, of Manchester, England. Owing principally to the processes invented by him for the manufacture of velveteen, these goods early acquired so high a reputation both in the home and foreign markets that Wilson's velvets sold in preference to those of every other manufacturer. His plan for cleaning off the loose and uneven fibers was by the use of razors. He afterwards successfully employed for this end-singeing spirits of wine and the application of a hot iron. At a later period he effected his object by drawing the goods over a metal cylinder heated to redness, by which they were effectually cleared of the down which, despite all precautions, becomes entangled in the pile during the various operations of weaving, washing, bleaching, dyeing, etc. Wilson having a turn for chemical inquiries, investigated the different known processes of dyeing; and by the improvements he

introduced in the application of them to his own manufacture, he materially advanced that art.

The manufacture of velveteen, for divers reasons, has never developed into an important industry in the United States. Many attempts have been made in this country to weave and dye the goods, but with a few exceptions none of them have met with much success. Manchester in England, and Crefeld, Elberfeld, and Barmen in Germany, are the principal European centers of the velveteen industry.

The method of weaving velveteen differs somewhat from that employed in the production of velvet and plush. Velveteen is woven by means of two systems of weft and one system of warp threads; whereas velvet and plush are woven by means of two sets of warp and one set of weft threads, the warp being drawn over wires in the form of loops. In velveteen weaving no wires are used, the object aimed at being the construction of a firm ground cloth with the pile wefts floating over the warps. The pile weft is inserted between plain- or twill-woven ground wefts, and is firmly bound in at intervals, so that when the floating portion is slit by the cutter, the ends may be brushed up to stand more or less erect. On leaving the loom, velveteen is technically known as "in the grey," and while in this state it has very much the appearance of thick sateen. The finishing operations to which the fabric is subjected are exceedingly complicated, consisting of dressing, singeing, bleaching, dyeing, and shearing. Previous to bleaching, the goods are dressed and singed for the purpose of setting up the pile and removing every particle of lint, nap, or floss, thus giving the face an even, level appearance. Great attention is given to these operations, and all possible care is taken to prevent the goods from being unevenly singed, as such a defect cannot be afterwards remedied. These operations are performed by means of specially constructed machines, and particular attention is paid to keeping the lengths of velveteen smooth and level while under treatment.

Woven Decorative Fabrics. Woven decorative fabrics are usually made on the Jacquard. Some very simple

designs may be made on a dobby. The following steps are necessary to produce a design:

The first step in the manufacture of a woven decorative fabric, *i.e.*, a damask, is to secure a proper design from an artist. There are certain artists who specialize in these designs. The design as purchased from the artist is on ordinary drawing paper in the colors and exact size in which it is to appear on the fabric, since the figure in a damask is made by alternately exchanging warps for filling or *vice versa*.

The manufacturer decides the construction of the fabric, e.g. 50 x 44, and the weave a 5-leaf satin (warp face) and the ground a 5-leaf satin filling face.

He then selects the proper design square paper to which to transfer the artist's design. The design paper must have the same proportion of rectangles as the proportion of warp threads is to filling threads in one inch of finished cloth.

We take as a standard for warp ruled paper 8 rectangles per large square. Then the paper for the filling will be ruled in the same rate to 8 as construction of filling is to the construction of warp, or 44 is to 50. Let x equal the size of the ruled paper for filling. The proportion becomes

$$x : 8 :: 44 : 50 \quad \text{or} \quad \frac{x}{8} = \frac{44}{50}$$

$$50x = 352$$
$$x = 7.04 = \text{approx. } 7$$

Therefore, 8 x 7 is the proper size of the design paper required for this design.

The design as it appears in the sketch must then be enlarged so that one repeat will exactly fit on the tieup,[1] which is two rectangles (warp) of the designing paper selected. That portion of the border shown at A in conformity to the tieup should occupy the first 15 squares or 120 rectangles; that shown at B the next

[1] The tieup is the arrangement of the harness cords. That is, Jacquard designs or repeats may be large or small. The large repeats or designs require more harness cords than the small designs.

15 squares or 120 rectangles. That portion at *C* is not required on the design paper because it is a repetition of that part shown at *A*, but simply reversed.

Then for the body of the design shown at *D*, 45 squares or 360 rectangles will be required, which will complete the two borders of the machine. To summarize:

Portion A = 15 × 8 = 120 rectangles — Border
Portion B = 15 × 8 = 120 rectangles } Body
Portion D = 45 × 8 = 360 rectangles } Body
600

To determine the number of rectangles the design will occupy fillingwise: The sketch must be measured; it may be 7 inches,

WOVEN DECORATIVE DESIGN
Artist's design

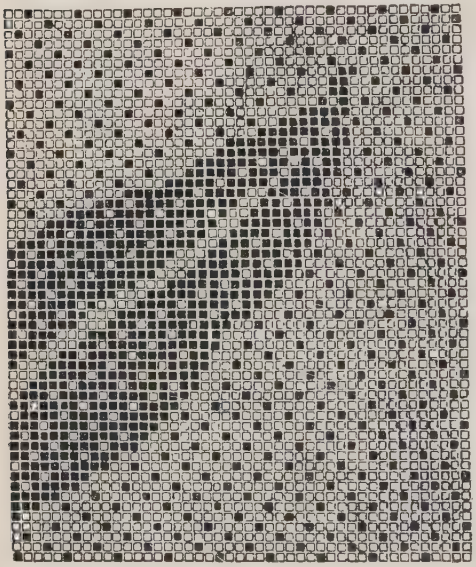
then 44 picks per inch x 7″ = 308 rectangles; but as 5, the number of threads in one repeat of weave (satin) will not divide 308 exactly, the next highest number, 310, must be taken. (310 divided by 5 equals 62.)

Therefore, the design will occupy two rectangles (warp) x 310 rectangles (filling).

After the design is transferred to the design paper, the next process is to paint in the weave, in the following manner:

1. Paint in the figure in solid red (vermilion or scarlet lake), keeping well within the lines.

2. Paint in the 1-4 satin twill in the ground, running the twill toward the right.



PORTION OF DESIGN ON SQUARE PAPER

3. Paint in the 4-1 satin twill in the figure by using black paint over the red. Twill to the left.

In joining the ground and figure twills great care must be exercised so as to effect a clear outline between figure and ground.

The cards are cut from the design paper. Each design represents the warp threads that are to be raised at each pick. This portion of the designing — cutting the cards and arranging the harness cords, etc., (tieup) — represents the mechanical rather than the artistic phase of textile designing.

Selling Points of Upholstery Fabrics. Hand-blocked heavy English linen is frequently used for draperies and cushion covers. The selling points of this line are quaintness, color, and design.

Cretonne is always bright, cheerful, easily washed, resists the dust, but fades in the sun.

Chintz (see page 263) is lighter weight and stiffer,

and has a brighter glaze than cretonne. The pattern is usually of a smaller design than cretonne. It is used for hangings and cushions.

Rep (see page 290) is not as beautiful as damask, but it is durable and is used for draperies and couch covers.

Casement cloth is a fabric similar to pongee, in either wool, mohair, cotton, linen or silk, used for curtains and shades. It resists dust and the sun and is easily washed.

Tapestry is the most durable of decorative fabrics and varies in price according to the composition, size, and design. It is the most durable of all fabrics because the interlocking of warp and filling is complete, making a fabric that will not ravel and that dust and moths find difficulty in destroying.

QUESTIONS

1. What is meant by the expression " upholstery or decorative fabrics "?
2. Name some of the most important upholstery fabrics.
3. (*a*) What is a brocade?
   (*b*) Give the history of the fabric and its use.
   (*c*) How is it made?
   (*d*) Define brocatelle.
   (*e*) What are its selling points?
4. (*a*) What is a damask?
   (*b*) Give the history of the fabric and its use.
   (*c*) How is it made?
   (*d*) What are the selling points?
5. (*a*) What is a stencil-dyed fabric?

(*b*) How is it made?
(*c*) State its uses.

6. (*a*) What is a cretonne?
(*b*) What are its uses?
(*c*) How is it made and what are its selling points?

7. (*a*) What is a tapestry?
(*b*) Give its history.
(*c*) How is it made?
(*d*) What are its selling points?
(*e*) Describe Gobelin tapestry.

8. (*a*) Define a velvet.
(*b*) What are the uses of velvets and plushes?
(*c*) Describe the various kinds of velvets.
(*d*) How is a fabric of this type made?

9. What is the difference between a velvet and a velveteen?

10. How is a velveteen made?

11. (*a*) How is a Jacquard damask design adapted to the loom?

(*b*) Explain the steps in transferring the artist's design to square paper.

CHAPTER XXXI

FLOOR COVERINGS

The principal floor coverings are carpets and rugs. Carpets were originally used extensively for floor coverings, but to-day rugs have generally taken their place.

A carpet is a heavy woven or felted fabric, usually composed of wool, but also of cotton, hemp, straw, etc., made in several widths to be sewed together, and intended to cover all the floor space of a room, as distinguished from a rug, which is woven in one piece of definite shape and designed to cover only a part of the floor. A carpet is made in strips about 27 inches wide and is sold by the yard. A rug, on the other hand, is sold as a whole and consists of a body and a border design. A rug is more sanitary than a carpet, and appears more attractive. There are different kinds of rugs and carpets, but each rug and carpet of the same name is made in practically the same way. The description of the manufacture of carpets applies equally well to the manufacture of machine-made rugs.

History of Carpets. The invention of carpets as a floor covering dates from a very remote period of antiquity. In Egypt they were first applied to religious purposes by priests, and were used to ornament the palaces of the Pharaohs. It was also a custom in antiquity to place them under the couches of guests at banquets. The Babylonians, who were very skilful in weaving

cloths of divers colors, ornamented their carpets with groups of human figures, together with representations of such fabulous animals as the dragon, the sphynx, and the griffin. These carpets were exported in considerable quantities to Greece and Rome, where they were highly esteemed. The skill of the ancient Babylonian carpet weavers does not appear to have been lost by their successors, for at the present day the carpets of Persia are as much prized and as eagerly sought after as they were when ancient Babylon was in its glory. Among the oriental peoples carpets or rugs were used for sitting or reclining, as well as for kneeling on in religious exercises. These were woven in one solid piece, richly figured, like the present Persian product. In Europe, from the 14th to the 16th century, this form of carpet was used for wall hangings, and was spread in the presence chambers of royalty, and before the high altars of cathedrals. The troubadours had carpets of gold embroidery, which they spread upon the grass beneath them while they played and sang. Many articles of furniture were also covered with them, — beds, couches, tables, and sideboards; but here it becomes difficult to distinguish between carpets and tapestry, both terms being used indiscriminately. Among the common people of Europe, the earlier fashion of floor covering was a thin spread of straw, herbs, or sweet-smelling rushes, it being only within comparatively modern times that textile fabrics have been used for this purpose.

The actual manufacture of carpets, in their more recent application, is assigned by historians to the reign of Henry IV of France, between 1589 and 1610, and is said to have been introduced there direct from Persia. This was extended in 1664 when Colbert, the great French minister, founded a manufactory at Beauvais. He was the minister who, in 1677, induced King Louis XIV to purchase the famous Gobelin tapestry works, and establish them as a government institution, under royal patronage. England witnessed her first successes in carpet manufacture through French weavers. In 1685 a skilled artisan left France in disgust, on account of political and religious persecution, and established the industry at Surrey. Many other French refugees followed him, and in a short time England began to produce carpets superior both in quality and design to the French

article. Almost a century later the English government offered prizes for the best imitation Turkish carpets, which eventually led to the making of those goods at Axminster, Wilton, and Edinburgh, which accounts for the success of English and Scotch floor coverings.

History of Carpets in America. Prior to the American Revolution, woven floor coverings, with the exception of domestic rag carpets, were practically unknown in this country. A few "Scots" (ingrain) carpets from Europe had found their way into some private city houses, but such a rarity were these that country people, on being ushered into apartments where they were laid, instinctively tiptoed around them, in awe lest they should soil them. In 1761, an American firm advertised Turkish carpets, and in 1763 both English and "Scots" carpets, but these were to be seen in the homes of none but the very wealthy. In 1776, the floor covering in most general use throughout the Colonies was the rag carpet above mentioned, made with a stout flax or cotton warp supplied by farmhouse spinning wheels. Then ensued the long war of the Revolution and the consequent commercial depression. The majority of the people, who possessed but little wealth before the war, were now in no condition of temper or purse to encourage the importation of English goods. About the close of the year 1791, the first carpet factory in the United States was built by W. P. Sprague, at Philadelphia. The first carpet made by the Sprague factory was a handmade, finger-tufted fabric, designed for the United States Senate chamber. Attracting the attention of Alexander Hamilton, it induced him, in his report on finance for that year, to allude to the new home industry, and to recommend, as an encouraging measure, the imposition of a small tariff on foreign carpets. There soon sprang up in Philadelphia and elsewhere small factories for the production of two-ply and three-ply ingrain and Venetian carpets. In 1825 a mill was in full operation at Medway, Mass.

Bigleow's Improved Machinery. Until the year 1840, the weaving of carpets of all descriptions was performed by hand. The attempt had been made repeatedly in England to adapt the power-loom to the weaving of ingrain carpets, but without success. About this time Erastus Bigelow, a young American inventor,

turned his attention to carpet machinery, and was trying, with small success, to interest carpet manufacturers. The object sought for was a loom that could make rapidly a carpet of smooth, even surface, a good selvedge, and figures that would match perfectly. In weaving by hand, the workmen can only approximate to regularity of figures. Bigelow's improved method of producing by steam-power patterns that would match was patented in 1845. The same machinery was found to be adapted to Brussels and tapestry, the weaving of which by power had previously been considered an impossibility. In 1849, ingrains were being woven at Lowell by handlooms at the rate of eight yards per day. With the adoption of power, 40 yards per day could be produced. The rate of increase in Brussels was from 4 to 20 yards per day, and in Axminster from $1\frac{1}{2}$ yards to 15. The application of steam power not only economized time and labor but it improved these fabrics until they surpassed the best of their kind in any other part of the world. The new invention completely revolutionized the weaving departments of carpet factories and made it possible to produce a beautiful and durable fabric at so low a price as to be within reach of the humblest purse.

Two Types of Carpets. Carpets, as manufactured at the present day, may be grouped into two general classes: (1) a double-faced fabric consisting essentially of two distinct webs woven at the same time, and held firmly together by the web threads, showing a pattern on each side; (2) the other general variety is distinguished by the raised pile upon one side, the back or foundation being composed of an inferior material such as jute or hemp.

Look at the face of an ingrain carpet or rug, and notice that certain colors form the figured effect, and certain other colors form the ground.

Ingrain Carpet. In England ingrain carpeting is known as Kidderminster, owing to its having been

manufactured extensively in the town of that name. The credit of originating ingrains, however, belongs to the Scotch, and they were long known under the title of Scotch carpetings, but the industry was appropriated by the Kidderminster manufacturers to such an extent as to nearly monopolize the entire trade of the world, and to cause the name of the town to be attached to them. Ingrain is a term used in connection with many textile fabrics, signifying "having been dyed before woven," that is, dyed in the grain or thread before the operation of weaving, in distinction from stamped or printed fabrics. Ingrain carpet consists of a cotton or woolen warp with a wool filling, and is woven in strips one yard wide. It is composed of two distinct webs interwoven together at one operation, and is, therefore, a double or two-ply carpet. Three-ply carpet is composed of three distinct webs, by interlacing and interchanging the threads of which a different pattern on each side is produced, and at the same time permitting much greater variety of color, with a corresponding increase of thickness and durability in the texture.

The ingrain carpet is a more complicated fabric than formerly, both in composition of yarn and in weaving. More colors are now introduced than was the custom a few years ago, and the yarn is more uniform in size, and in this respect better. The best quality of all-wool extra super ingrain has 1080 warp threads to the yard (30 to the inch), and $13\frac{1}{2}$ pairs of filling threads to the inch. This is the largest number of filling threads beaten into any extra super carpet made on a power loom. In some patterns these threads are doubled and twisted to produce certain effects in color. To make a cheaper quality of carpets, the filling-threads are lessened a half pair at a time until they are reduced to six

pairs to the inch, which latter is the lowest grade made under the title of all-wool ingrain. Thus, the quality of ingrain carpets is determined by the number of pairs of filling threads per inch (commercially known as 6, 8, 10, up to 13½ pairs per inch). This is similar to the method of indicating the quality of Brussels and tapestry by the number of ribs or " wires " per inch. Twelve-pair supers contain 12 double weft threads to the inch, and 960 warp threads to the yard. This grade is usually preferred by consumers, on account of its being all-wool and holding its color without fading, although in point of fact it is not so durable as the best extra super made with wool filling and cotton warp. The latter contains the same number of threads, both warp and weft, as the all-wool extra super.

Wool-filling ingrains are seldom made in lower grades than eight pairs to the inch. Union extra supers were originally made of cheap wool and cotton, carded together for the light colors; and, while the weft was part wool and part cotton, the warp was all of cotton. At the present day competition has so cheapened them that they are frequently composed entirely of cotton. These are termed in trade, 12-, 10-, 8½-, 7-, and 6-pair cottons.

Previous to 1860, ingrain carpets were woven altogether by hand, no power looms being put into practical use until after the close of the Civil War, about which time the adoption of the power carpet loom became universal. In Philadelphia about 3400 power looms are in operation for ingrain carpets; in other sections of the country there are 1400 more, making altogether 4800 looms with a daily capacity of 192,000 yards of carpeting when in full operation. In Brussels, Wilton, tapestry, velvet, and moquette looms 3400 are at work in the various mills throughout the country, with a capacity of 153,000 yards per day. This, coupled with the annual production of the ingrain looms, gives a total annual production of 103,500,000 yards.

Brussels Carpet. The carpeting known in trade as Brussels was first manufactured at Brussels, Belgium, in 1710. In 1720 it was first produced in England. This carpet became known as Brussels from the city

where it was first made, and in like manner Royal Wilton received its name Wilton from the town and Royal from the charter. When borders came to be used, they were generally stock-numbered the same as the carpets to which they belonged. Frequently there was a stair carpet also, which matched the carpet and border, and had the same stock number. These were then and are at the present time distinguished by the terms, " body," " border," and " stair."

Examine the surface of a Brussels carpet and note that it is composed of loops of worsted yarn packed closely together, forming ribs running from side to side of the web. These loops (collectively called the pile) are raised from the back or foundation by the yarn being passed over and around stout wires, as long as the width of the fabric. Wire after wire is covered with the yarn, until some eight or ten rows have been formed. Then the wire which was first covered is withdrawn and inserted in front; then the one next to it, having served its purpose, is withdrawn and placed in front, and then the next, and so on, one wire succeeding another as the weaving of the carpet proceeds, eight or ten wires, however, always being in the last-formed portion of the fabric. A variable number of these wires may be put into one inch length of carpet. The number used to the inch has a special significance, as this is one of the standards used to indicate the quality of the carpet. An 8-wire Brussels signifies that eight wires have made eight ribs on the surface of the carpet in one inch of its length; 9-wire means nine ribs to the inch; 12-wire, twelve to the inch, and so on, the greater the number of wires to the inch the better the quality of the carpet. The essential difference between a Tapestry Brussels and a Body Brussels carpet is, that in the former the worsted is all on the surface, while in the latter it is continually being mixed with the body of the fabric during the process of weaving, a process which contributes much to its durability.

The more colors there are in a Brussels carpet, the more expensive it is. The reason for this is that when any one of these

colored threads is not needed to show in the pattern, it must be buried out of sight in the body of the web. The number of colors a Brussels contains represents one of the two standards used to indicate the quality of the carpet. The higher the frame, as a general rule, the better the carpet, although a lower framed carpet may be as close in texture and as expensive and as durable as one constructed with a higher frame. The origin of the word "frame" is due to the fact that the different colors of yarn are wound upon separate frames of bobbins. The wire frames containing the bobbins — whether one, two, three, four, or more in number — are placed in a horizontal position behind the loom.

The number of colors in the pattern of the Brussels carpet is called so many "frames." A 4-frame Brussels contains four colors in the design, a 5-frame, five colors, and so on. Each color represents a continuous layer of thread, running from end to end of the web, rising to the surface at short intervals, as indicated by the design, and then sinking out of sight in the body of the carpet. In Brussels all the colors used show the pattern more or less distinctly on the back of the fabric. In tapestry they do not show on the back at all.

Warp Pile Fabrics. Brussels carpets belong to the class technically called warp pile fabrics, which means that they are produced by taking some of the warp threads and weaving them in the form of ribs on top of the actual interwoven part of the fabric. The ribs or loops appearing upon the face are formed, as previously explained, by the worsted warp yarn being woven over wires. Thus, it will be seen that two kinds of warp are necessary for the production of these fabrics. The ground warp is a strong, durable thread, made generally of flax or jute. The other is the pile warp, forming the face of the fabric. While the face of a pile fabric is built up of pure wool to make it soft and

elastic to the tread, the back is built up so as to be firm and solid, for the latter must act as a cushion between the floor and the elastic surface. To give the best results, it must be flexible, yet firm as a board. To accomplish this, the backing threads are boiled in glue before the weaving process begins, and while wet are used in the carpet. The glue fastens itself to all the threads that it touches and binds them fast, thus adding to the solidity of the carpet as nothing else would.

Moquette Carpet. The carpeting known by the French name of moquette is in reality a fabric of American origin. The word *moquette* means in French " tufts of wool." This variety of carpeting was first placed upon the market in the year 1875. The old imported Axminster, with its deep, heavy pile, had long been beyond the reach of the average housekeeper's purse, and the moquette was introduced as a less expensive substitute. In America it sprang into immediate popularity, though in foreign countries it has not met with very general approval. At present the name Axminster is used to designate a carpeting which is practically the same as moquette, differing mainly in the number of tufts of wool to the inch, or in the manner of fastening the tufts more or less firmly in the fabric. Moquette, while woven somewhat after the manner of Brussels, should, strictly speaking, be classed among Axminsters. It is a ribbed-back fabric with a deep tufted pile, capable of wonderful color treatment.

The loom upon which moquette carpeting is woven is a product of native American genius, having been invented in 1856 by

Halcyon Skinner, then in the employ of Alexander Smith & Sons Carpet Co. The process of manufacturing moquette is as simple as it is ingenious. In the Skinner moquette loom the foundation warp is composed of two parts, mounted on separate beams, and comprising threads of different grades of fineness. The warp of coarser threads is under greater tension than the other, so as to be kept as straight as possible; that of the finer thread being under less tension, so as to be bent around the woolen pile-tufts and the weft threads. The straight or coarse warp is subdivided into two parts, one being called the tufting warp, because the tufts are secured to it, and the other the body warp, because it gives firmness to the fabric. The yarns which are to compose the pile, having been dyed the desired colors, are wound on spools of the same length as the width of the carpeting, so that each yarn may be directly opposite the point where it is to enter into the pattern. These spools are placed upon an endless chain in the order in which they are to be used, and have a spring at either end by means of which they are kept in position. When the loom is in motion, the spools are automatically taken from the chain, and the yarns (guided by a series of small tin tubes) are seized by ingenious contrivances and, having been carried down through the warp threads, are bound in and turned up. The heddles are then operated so as to hold the yarn in a position, and two steel blades cut the tufting from the several parcels in the spools. In this manner a single row of tufts is woven into the backing of the fabric. The same operation is repeated for the next row, and so on continuously. When the carpet comes from the loom, its surface is so nearly smooth and even that very little subsequent shearing is necessary to prepare it for the market. The color effects of moquette are usually soft and delicate, and the pile deeper and more dense than that of velvet carpeting.

Aristo Carpet. A name sometimes applied to Royal Axminster, differing from it only in the pitch, or number of points, to the square inch. Aristo is practically the same fabric as the moquette carpeting of the United States.

Aubusson Carpet. A name applied to a class of fine pile carpets originally manufactured in the royal factory at Aubusson, France, but also made elsewhere. Aubusson carpets are made in one piece, of either silk or wool, the designs now usually being in imitation of the needlework style of the East Indian carpets. On account of their purely decorative character and exceedingly high cost, they are not produced commercially.

Axminster Carpet. Axminster carpet takes its name from the original seat of its manufacture, Axminster, in Devonshire, England. Here in 1755 was produced a species of finger-tufted carpeting constructed in the same manner as the rugs and carpets of Persia and India, which they were intended to imitate. In point of fact, the hand-made Axminster of the 18th century rivalled the work of oriental looms in beauty, durability, and color; but, owing to the cost of their manufacture and the introduction of the cheaper Brussels carpets, the demand became very small, and in 1835 the work was removed to Wilton.

In the construction of real Axminster carpet there are used from 16 to 20 warps per inch of strong cotton or linen thread; the weft or tufting is of fine wool, three ply being put into each tuft. The tufts are knotted to the warp threads in practically the same manner as the oriental product. The back or binding weft is usually of flax, thus producing a full, soft, and flexible fabric. When the ends of the tufts are sheared down to a common level, the carpet is about three quarters of an inch in thickness. The construction admits of the most elaborate patterns, comprising an unlimited variety of colors. Real Axminster together with certain other high grade carpetings now being produced may be classed as works of art. The demand for them comes from quarters

where more importance is attached to quality and artistic effect than to price, — such as clubhouses, fashionable hotels, and the homes of the very wealthy.

Royal Axminster. The Axminster carpets of commerce are the Royal Axminster or moquette (commonly known in the United States under the latter name), and the Patent Axminster or chenille carpet.

Patent Axminster. The Patent Axminster or chenille carpet was first brought out by James Templeton, a chenille shawl manufacturer of Glasgow, Scotland, in 1839. It is at present made both in this country and in Europe on power looms especially constructed for the purpose, and which of late years have been greatly improved, enabling the manufacturer not only to weave the fabric in any ordinary width as well as in piece lengths, but also to increase the number of colorings.

The number of colors used is sometimes as high as 10 or 12, but generally not more than from four to six are employed. The colors are not printed as in tapestry carpet, but are dyed in the yarn. Further, these carpets are a pile fabric, and can be woven of a depth equal to any oriental production; while for density, smoothness, and firmness of texture they cannot be surpassed. The manufacture involves two distinct weaving operations: (1) the preparation of the chenille or "fur," the strips of which form the weft; (2) the weaving proper. A design for the carpet to be woven is first prepared and accurately laid down in its proper colors on paper ruled into small squares. This design is then cut into narrow longitudinal strips and given to the chenille weaver to guide him as to the colors he is to use. In the breadth of this web there may be a dozen or more separate chenilles, and consequently there are as many separate repeats of the pattern available for the weaving which follows. The first web is cut into strips along its whole length, according to the number of separate chenilles it contains, and the loose edges fold together by a device in the weaving, so that a double pile projects upwards from a firmly woven center or back.

These chenille strips now form the weft for the second weaving,

and being woven into a strong linen or hempen backing in the same order that the strips were cut off from the original pattern, the colors combine as in pattern, and the elements of the complete design gradually come out as the weaving proceeds. Each length of the chenille strips thus makes up a complete section of the same design, and if twelve strips were woven in the breadth of the chenille web they would give weft material necessary for twelve repeats.

Carpet Binding. A species of heavy, wide tape, woven in simple ingrain patterns, of both cotton and wool, used for binding the edge of rag and ingrain carpets. In width it varies from one to two inches and is generally put up in rolls containing 12 yards.

Carpet Lining. Material of any description used to put under a carpet to keep out the cold, or to render the carpet more elastic to the tread. Usually there is used for this purpose a thin padding of carded jute or cotton enclosed between strips of paper and made to adhere to the latter by pasting, or by several rows of stitching. Material of this description is commonly made 36 inches wide and put up in rolls of about 200 yards.

Carpet Thread. A variety of heavy, strong, linen thread, put up both in skeins and on spools, used for sewing together the strips composing a carpet.

Carpet Warp. A variety of strong cotton yarn or cord, very hard and evenly twisted, used for the warp in the manufacture of rag carpets. It is commonly 4-ply and is put up both in 5-pound bundles and half-pound balls.

Carreau (*kah-ro*) (French, *carreau*, square, spot of ground). In weaving, a term used to describe the character of the pattern, signifying a small check or square; sometimes applied to a diamond-shaped spot.

Felt Carpet. A variety of floor covering formed of narrow strips of heavy felt, set on edge and tightly laced at close intervals through their centers. Felt carpet is alike on both sides and is distinguished for its softness and durability.

Hemp Carpet. A coarse, stout variety, made of hemp or jute fiber, usually woven with open mesh, so as to permit the dust and dirt to sift through it. Hemp carpet was originally imported from Russia, but is now made in large quantities in Philadelphia

and other eastern carpet centers. It is extremely cheap and durable, and is used mainly in business offices, passage-ways, and public halls, where a cheap, stout carpet is required to deaden sound. A floor covering used for similar purposes is also made of cork.

Knitted Carpet. A coarse, home-made variety of floor covering introduced into this country and Canada by emigrants from Germany. The fabric is made of narrow strips of cotton or woolen cloth, usually cut from discarded clothing such as is utilized for our common rag carpeting. The knitting is done with wooden needles, and for convenience in this respect the fabric is made only 12 inches wide, the widths being joined together by sewing. The manufacture is a home industry of certain parts of the United States, and the product is claimed to be much more durable than woven rag carpet. Schools for teaching the art of knitting this floor covering in fancy patterns have long been established in many towns in Germany, and it is stated that itinerant carpet-makers travel from place to place teaching the art for a small remuneration.

List Carpet. A species of floor covering formed of narrow strips similar to rag carpet, the principal difference being that the weft is composed of list obtained from tailor shops and clothing factories. List carpet is made by all regular carpet factories, the material measuring 36 inches in width, and is put up in rolls containing 130 yards.

Paper Carpet. A comparatively recent addition to the family of hygienic floor coverings, used in a limited way for public dining-rooms. It is produced by subjecting paper pulp to the action of chloride of zinc, and then to powerful pressure. By this means the paper is rendered as hard and as tough as leather, but more elastic. It is finished plain and also in imitation of ornamental wood.

Rag Carpet. A variety of carpeting which originated during the latter part of the 18th century among the economical farmer folk of New England. Until 1874 no large factories for the weaving of rag carpet were in operation in the United States. Prior to this date the industry was carried on exclusively by families residing in rural communities, the cutting, sewing, and dyeing of

the rags and weaving of the web being done by the women of the household. The weft of the fabric is composed of cotton or woolen cloth, cut usually from worn-out and discarded clothing. As the strips are cut they are sewed together into a continuous string and wound in huge balls. Sometimes the strips are dyed in appropriate colors for the production of a pattern of stripes.

The warp is of heavy cotton yarn, dyed in a great variety of plain colors. For every 3 yards of carpet $1\frac{1}{4}$ pounds of warp are required. In the manufacture of the home-made product the weaving is done upon old-fashioned hand looms, a good weaver being able to turn out about 12 yards per day. Homemade rag carpet is not in so general use as formerly, having been largely superseded by low-grade ingrain. The latter is preferred by the majority of consumers on account of its ornamental pattern and bright, lively colors, though in point of durability it ranks far below the homely pioneer fabric.

Real Carpet. A name frequently used to designate wholly hand-made carpet of artistic design and coloring. To this class belong the carpets of India, Turkey, and Persia. Widely different varieties are made in the different districts, ranging from coarse makes, with less than 16 points or tufts to the square inch, to as fine a pitch as 400 points to the square inch. In most cases the real carpets of the Orient are made with a pile surface.

The loom used is a very primitive arrangement, consisting simply of two horizontal beams or rollers fixed at the top and bottom of two upright supports. The warp threads are wound and stretched around these rollers. The pattern is formed by knotting tufts of wool (sometimes of silk and cotton) around the warps. After each row of tufts is tied in, a weft thread is beaten up, thus fastening them securely. The row is then firmly beaten in with a heavy woolen comb. When the piece of carpet is finished, the pile is sheared down to a common level, and the warps knotted at either end in the form of fringe.

Savonnerie Carpet. A variety of art carpet composed wholly of silk, produced originally at Savonnerie, France. Savonneries are made in one piece, of various sizes, and range in price from $200 to $500 per carpet.

Brussels and Tapestry. The ordinary observer is quite unable to distinguish between a Brussels and a tapestry carpet (except by an examination of their backs), though there is a vast difference. When samples of each are placed side by side and examined closely, there will be noticed a clearness and sharpness about the Brussels pattern which is absent from the tapestry. In the latter there is a mistiness about the colors, and the pattern lacks that delicacy of outline which is a chief characteristic of the former. This is wholly due to the respective processes of manufacture. In Brussels, each color has its independent thread, and the number of colors is limited to six at the most. The tapestry, on the other hand, carries all the colors on one thread, as many as twenty-five frequently being used. To produce the best results in tapestry weaving, the utmost nicety and precision are necessary in the allowance for loop and shrinkage of the yarn, in order to make colors and shadings come exactly where designed. A slight variation causes a blurred appearance, which destroys to a greater or less extent the effect and meaning of the pattern.

Tapestry Carpet. The process of tapestry manufacture was invented and patented in Edinburgh, Scotland, by Richard Whytock, in 1832. Later the patent fell into the possession of the Crossley Company,

of Halifax, England. For a quarter of a century or more the new process experienced many ups and downs. In both Europe and America improvements and alterations followed thick and fast, each in turn revolutionizing the industry and making increased production possible. In the United States this variety of carpeting was first successfully made in 1870, since which time it has steadily grown in popular favor. Tapestry is composed of a stout back of vegetable fiber (generally jute) and a face of worsted yarn.

The manufacture is most peculiar and ingenious. It is a combination of weaving and printing, a surface very similar to Brussels being produced in which any desired number of colors may be used. This is accomplished, too, by the use of only a single thread, instead of the five or six required in a Brussels texture. In tapestry weaving the ordinary process of printing is reversed. The warp, forming the pile of the carpet, (one thread, or two twisted as one, sometimes miles in length,) is colored by steps of half an inch or so faster than the swiftest runner could make a quarter of the distance. In the printing process the plain, uncolored yarn is wound tightly around a huge circular framework of iron, termed a "drum." In this position certain short sections of the yarn are given one color and certain other sections another color, as the design may direct. For each color printed upon the yarn a separate color-box is required, furnished with wheels, in order to pass in and out under the drum. As the boxes containing the different shades of dye-matter run along backward and forward, a small disc presses against the yarn and stamps on the color, leaving an impression on the yarns across the full width of the drum. When the thread has been parti-colored in this manner, it forms the elements, as it were, of the intended pattern of the carpet. Singly, in the long thread, it exhibits no regular figure, but when woven up in proper order, the pattern comes into view little by little as the thread is looped around the wires. Tapestry yarns, after being printed, are subjected to a steaming process,

which fixes the color permanently. After steaming, the yarn is washed in cold water and thoroughly dried, when it is ready for the loom.

Unlike the Brussels principle of weaving, in which the colors cannot exceed five or six, any desired number of colors may be introduced into a tapestry. The manner of forming the ribbed pile by looping the yarn over metal wires is the same as in the case of Brussels. The back of a tapestry shows nothing but the plain jute foundation into which the pile is fastened; though sometimes unscrupulous manufacturers stamp the back in imitation of a Brussels weave, for the purpose of deception. The color grows dim and the pile crushes down much more quickly in tapestry than in Brussels, but as an offset to this it is proportionally lower in price. As in Brussels, the quality is determined by the number of ribs to the inch, termed in trade 10-wire, 9-wire, and 8-wire taps; the smaller the number of ribs or wires to the inch, the less the cost of producing the carpet.

Velvet Carpet. A variety of carpeting bearing a close relationship both in appearance and construction to tapestry. Like the latter, it is made from one length or frame of parti-colored yarn, looped over wires and then cut by a machine in which a small knife passes under each row and severs the loops. Velvet, though handsome in effect if the design be good, is neither so durable nor so rich as Wilton or moquette. The pile has more luster than that of a tapestry, owing to the color being given off from the ends, instead of from the sides of the wool fibers.

Venetian Carpet. A low-grade floor covering of simple structure, made originally with a coarse woolen warp and a filling of jute or hemp, but at present composed entirely of cotton. The fabric is ornamented for halls, stairways, and bed-rooms. For many years the production of Venetian was an extensive and

profitable branch of Philadelphia manufacture, but in recent years it has been largely supplanted by the lower grades of ingrain carpet.

Wilton Carpet. This variety of floor covering received its name from the place of its first manufacture, the town of Wilton, England. Wilton carpet is a variety of Brussels, the process of weaving the two being identical. Wilton, however, is very much heavier and has a plush surface. The pile of each is first woven by means of wires in the form of loops, the loops of the Wilton being cut. To effect this, the wires over which the yarn is looped are not round and smooth like the Brussels wires, but, instead, they are flat and furnished with a knife edge at the top, and as they are withdrawn this edge neatly severs the row of loops. Wilton is unexcelled for durability, the yarn being made of very strong non-felting wool. In Wilton carpeting of high grade there are over 2000 threads of worsted warp employed on the 27-inch web, thus producing a surface extremely dense and lustrous. Wilton has the advantage also of being made in very beautiful and choice designs, particularly the Royal Wilton, in which the pile is raised much higher and is denser than in the common fabric.

Types of Rugs. In this country the cheaper grades of floor rugs are made on power looms, while the finer sorts are hand-made and are imported from the Orient. While the products of American carpet looms, by reason of their richness and beauty, have become popular in the principal markets of the world, it is, nevertheless, a fact that the rugs of the Orient, on

account of their wearing qualities, their softness, and their harmonious colorings, continue to maintain their high estimation in the mind of the public.

The modern tendency to use hardwood floors in the construction of dwellings, the fact that decorators are now lending their influence to the use of rugs, and that physicians recommend them for hygienic reasons, account in large measure for the heavy inroads these fabrics have made in the demand for machine-made carpets.

Oriental Rugs. Among lovers of true art, the oriental rug or carpet is prized far above the machine-made product. The reasons for this will be readily appreciated when pointed out. In the first place, the exquisite taste and skill of the oriental weaver are shown not only in the beauty and novelty of the pattern of his product, but also in the richer and more harmonious colorings. In addition, these rugs are the most durable textiles to be found in the world. They are built up knot by knot, so slowly, skilfully, and laboriously, that when complete, the life of the fabric is not merely for a few short seasons, but for generations. In the preparation of both the wool and the dyes the utmost care is taken. In some districts the sheep are even kept wrapped in blankets and housed in order that the wool may be of the finest texture. The colors chiefly used in dyeing are what have been called the perfect seven: indigo, porcelain blue, green, yellow, orange, crimson, and rose red. The dye matters for the production of these colors are generally of vegetable origin, and for ages the method of their preparation has been guarded with the most jealous care and the secret handed down from one generation to another. Unlike aniline dyes, which maintain their full brilliance for only a limited time, the vegetable dyes produce pure, perfect shades, which not only endure for centuries, but actually improve with age and wear, taking on a beautiful luster with the passing years.

An additional reason for the high esteem in which the oriental rug is held is that it is essentially a hand product. Whether it be a " modern " or an " antique " it bears the imprint of human labor, and mutely tells of days, weeks, and months of laborious toil. Many oriental rugs and carpets are rich in exquisite subtleties of color and design and often are found to be replete with symbolism. The story of a rug may be read in its form, pattern, and colors. The rug itself symbolizes space and eternity; the complete pattern, the universe of animated beauty. The lion stands as a symbol of the sun, day, summer, victory, and glory; the antelope and the unicorn are symbolical of the moon and night; the dragon, of death, destruction, and dark, stormy night. Flowers also have a meaning interpreted in their drawing and colors, and are supposed to possess a hidden power to avert the evil eye and secure good luck. Only a native Turk or Persian can read the characters of a rug thoroughly, especially if it be an antique, for there is much in them which remains entirely hidden to any but those intimately acquainted with oriental history, religion, and folk-lore. The care an oriental takes of his rugs is unknown among Western people. No chairlegs make holes in them and no dusty shoes tread upon them. If he walks upon his rug, it is with sandals removed, and the soft, even pressure of his feet is more like a caress than a common footstep. The great care taken is in part an explanation of the fact that an oriental rug hundreds of years old is as good or better than when it was first made.

Throughout the Orient to-day, as for unknown centuries in the past, the people as a class are weavers. Always a household art, and originally a labor of love or veneration, rug making began as a work where time counted little. In the early history of the manufacture of these articles considerably more attention was paid to their production than is the rule at present. Sometimes years were consumed in the weaving of a single rug, and it was not looked upon as a remunerative employment, but purely as a labor of love. Rugs were made as special gifts for celebrated personages, or to priests, and as wedding presents for favored relatives, by whom they were treasured and handed down as heirlooms from generation to generation.

Within recent times customs have changed somewhat, and on

this account we have what are termed antique and modern rugs. The antique differs from the modern only in name. Naturally, to justify the use of the term "antique," the rug should be very old; in order to attain the mellow harmony which marks its beauty, it must have been subjected to many years of exposure to the sun and dust. The real antiques are distinguished from the modern by their particular fineness. They are always more expensive for this reason, as well as because of their subdued colorings which age and wear alone can give. Made at a time when doubtful practices in yarn-dyeing were unknown, nothing but the best results were obtained. Many rugs are classified as antiques which probably have seen no more than fifteen or twenty-five years of wear. This length of time will often, but not always, soften the colors and develop a considerable luster.

A modern oriental rug is commonly understood to be one practically made for the market. Exactly the same methods are employed in making the modern rug as the antique, both being made entirely by hand, and nothing but the best vegetable dyes being used. The modern, however, is generally of coarser texture and consequently costs less. Many of them are produced by peasants who grow their own wool, dye their own yarns, etc., and in this way furnish all the labor needed to complete the rug. It is seldom that oriental weavers copy from set designs, but instead depend entirely upon their own taste and judgment for patterns and colors.

Genuine Oriental Rugs. The most inexperienced can readily distinguish a genuine oriental rug from an imitation by noting the way in which the pile threads are fastened into the foundation. In the oriental every tuft means a separate stitch. As soon as the thread is pulled through, it is twisted and tied around the warp in a peculiar square knot, after which the ends are cut off evenly with a pair of scissors, thus forming the upright pile. The pure oriental rug never exhibits a hard combination or even a grouping of hard colors. Why one rug should cost more than another of equal size, and to the average eye of equal beauty, is somewhat difficult to explain. It has much to do with the history of the art, and not a little with the history of the artisan. It should be borne in mind that the value of the oriental rug is always regu-

lated by the variety of the design and beauty of the coloring. Often one of inferior texture will possess some charm of this kind for which an extra price is demanded and easily obtained. An oriental rug is said to be fine or coarse according to the "pitch" or number of "points" (tufts) per square inch that it contains. A Persian rug, for instance, has double the number of tufts in the same space that an Anatolian has. Thus, the same design in one would be small and close, while in the other it would be large and coarse, and the values would differ accordingly. The number of tufts per square inch beyond a certain limit, however, does not add to the quality or durability of the rug. From thirty to forty are all that are necessary for ordinary use, and eighty knots represent a fineness that should not be exceeded, as it would but increase the cost without adding anything to the beauty or durability of the rug.

Many attempts have been made to imitate oriental rugs, but without success. No machine has ever been invented which can give the twist to the yarn and tie the square knots which are the peculiar features of the hand-made fabrics. The native Persian or Turk can do it almost from the day he is able to stand at the loom, but his knack is largely inherited. Even in the most ordinary qualities the knots are so minute as to be almost invisible to the naked eye. The weavers of the Orient at the present day weave as their fathers and their fathers' fathers did before them.

Persian Rugs. The rugs generally regarded as the most perfect products of the oriental loom are made in the various districts of Persia. Prominent among these is the *Kurdistan* rug, which is noted particularly for its fine texture and rare weaves. Many of them are ornamented with floral patterns, others in the mosaic style, and, while no two patterns are found alike, they are in most cases very rich and intricate.

The province of Kurdistan is fortunate in possessing a peculiarly choice grade of wool, that is at first hard, but which softens

wonderfully with age. The variety of rugs known as *Khorassan* includes several makes, all easily distinguishable by the patterns, which are large, and by the texture, which is coarse and heavy. The Khorassan may be described as running generally to vivid colorings. They are made principally in carpet sizes, very few small rugs ever being found among them. One of the most appreciated of Persian rugs is the *Serebund*. The prevailing design is the so-called palm-leaf in red on a deep blue ground. The very best and closest woven Serebunds are called *Mir*. Of more artistic nature and in appearance similar to tapestry work, are the *Sedjades* rugs. These are less used for floor coverings than for wall hangings, and in them are found some of the most beautiful rug pictures of the Orient. In execution, coloring, and general technique these daintily woven scenes are as true as painting. Following them, and of an exquisite gracefulness of design and harmony of color, is the *Senna* rug with its close texture and short, silky pile, made from the fine hair of the Demavend goat. In size these rugs seldom exceed 5 x 7 feet.

It is from *Kermân*, however, that the finest rugs of Persia come, and the fabulous prices that have been paid for some of the wonderful antiques of this make attest the consideration in which they are held. They are made only in the province of Kermân, whence they take their name. The weave is the finest and closest known, with a silkiness and luster almost equal to that in the silk rugs. The antiques, especially, present a beautiful velvety appearance. In its wonderful old gold and ivory grounds, this rug is probably the best example of the lost art of dyeing. *Shirâz* rugs are from the southeastern parts of Persia and the northern parts of Arabia. They have a long fringe and a very wide knit piece of the warp on either end. Usually they are ornamented with designs of birds, animals, figures, etc., and are bright in color. *Moussul* rugs, which are generally sold and classified among the Persians, are really made in several Turkish provinces. They are largely sold by Mecca pilgrims in Bagdad. While as a rule Moussuls are not of a very fine weave, they are frequently very silky and beautiful in design.

Of all the rugs of Persia the *Hamedon* is the cheapest. It closely resembles the *Heraz* both in coloring and design, and like

nearly all Persian rugs is remarkable for its durability. Heraz carpets and rugs are cheap varieties, characterized usually by pronounced medallion centers with pretty borders in various designs and colorings. The *Fereghans* are among the cheapest of the oriental products. They are of loose texture, quite heavy, and particularly noted for their simple patterns and bright colors. Antique Fereghans are very scarce, but when found, compare favorably with some of the better varieties. Among other well-known and highly prized varieties of Persian rugs may be mentioned the *Teheran*, *Shirvan*, *Herat*, and *Djosgan*.

Turkish Rugs. Generally this class of rugs may be distinguished by its coarser yarns, larger and heavier pile, and more numerous varieties. The design is usually purely imaginary, the Turk seldom receiving his inspiration from anything in nature.

Commencing with the poorer and more common makes, the first to be mentioned is the *Carabaugh*. Usually red predominates in the coloring. The Carabaugh belongs to the same general class as the *Guendje* and the *Kazak*. The latter, however, runs in square shapes and is heavier.

A long step in advance of these is the *Daghestan*, characterized by a short, close pile, nearly approaching the finest Persian. Among the Daghestans one of the most common designs is the so-called prayer rug. It is upon the prayer rug that the Turkish weaver expends his utmost taste and means. The design is nearly always oblong and rectangular, except at one end, where it comes to a point, the point always being laid toward Mecca when the Mohammedan kneels upon the rug to say his prayer. Frequently, places are provided for the hands and forehead to rest upon. The genuine antique prayer rugs are above all others most sought after and most difficult to secure. They are found in every Turkish household, and are regarded as a most sacred possession. The design of the prayer rug, being an easy one to imitate, has been extensively copied, and to-day can be found in numerous makes of rugs. In the same class with the Daghestans may be included the *Cabristan*, *Chichli*, and *Bakaran*.

Anatolians. Among the most beautiful of all Turkish rugs are the Anatolians, woven of long, silky wool and having a close

texture. Warm shades of red, old gold, and rich indigo blues predominate in the patterns, which latter are always large. Anatolians are made in two sizes: in the form of mats 18 inches wide and about 30 inches long, and in rugs about $3\frac{1}{2} \times 5$ feet. Among the antiques of the latter are often found extremely rare and valuable pieces. Since the massacre of the Armenians, the rug industry of the Anatolian provinces has practically ceased. The Anatolians are almost invariably woven as prayer rugs. The fine antiques may be classified with the *Ghiordes* (not the cheap modern ones), and the beautiful weaves of *Melet*, *Zadik*, and *Korna*. All of these are scarce and very valuable, and are chiefly used for hangings and table covers, being really too light for floors. The Ghiordes are an especially bright weave and are famous for certain peculiar tints of red and yellow which they display. The *Moussul*, though really a Turkish rug, resembles the Persian school so closely that it requires an expert to tell the difference. The texture is rather coarser and heavier than the Persian, though the designs are much the same.

Bokharas. Of all the carpets known as oriental, the Bokhara is probably the most familiar pattern and the one most promptly recognized wherever it is seen. It is a carpet with a dark red background, on which are placed small figures in black and varying shades of red and blue, the pattern always the same as it has been for many generations. It is a favorite covering for the floors of libraries and dining-rooms, and good carpets of this kind are highly valued for the excellence of their color and texture, which improve with age. The name Bokhara is altogether a misnomer. Upon an investigation it was found that instead of being made by the Bokhariot, they are produced by the man-stealing Turkomans, the Tekin of the desert of Transcaspia.

Indian rugs are not used to any great extent in this country.

The Selling Points of a Rug. 1. A rug is easier to clean than a carpet.

2. It should have sufficient weight in the fabric to lie flat on the floor.

3. The color and design should not be gaudy or large.

4. A rug should harmonize with the rest of the room.

5. A hall-room rug should be brighter than other room rugs.

6. A smooth surface or uncut pile is easier to take care of than a cut pile.

7. A short, close-pile rug gives longest wear, — preferably worsted yarn with linen backing.

8. Cut pile shows to better advantage because the long, soft pile effect gives a velvet-like surface.

9. Cotton rugs wear shabby quickly due to short fibers, and they soil easily on account of the porous nature of the fibers.

10. The Wilton rug is serviceable but hard to keep clean because the cut pile absorbs the dust.

11. The closer the weave, the better the rug.

12. A velvet rug has a printed warp. It has a closer construction than Axminster, but not so close as a Wilton.

13. Wilton rugs are medium grade rugs of different values depending on composition, nap, and coloring.

14. The Axminster rug has a long nap (soft) in bunches, and is not durable because the nap wears off.

15. Chenille is one of the most expensive rugs, due to the soft, fluffy yarn used.

16. A Brussels rug has un uncut pile and does not catch the dirt so easily. As the composition is cotton and jute it does not look as rich as a velvet or Wilton.

17. An ingrain rug is very serviceable because it has no pile, and, of course, has not the velvety beauty of a pile rug.

18. The Persian rug is the best for softness and richness of color, due to high-grade composition, careful weaving, good designs, and coloring.

19. An oriental rug is valued according to age, number of stitches to the inch, composition, richness of coloring, fineness of design.

20. An oriental rug may be told from a domestic rug by comparing the backs. In the oriental the whole pattern is shown in detail on the back.

QUESTIONS

1. What is a carpet? Give its uses and its history.

2. How were carpets originally made? How are they made to-day?

3. Name the different types of carpets. How do they differ in appearance?

4. Describe the various manufacturing methods of the different kinds of carpets.

5. Compare ingrain and Brussels in appearance.

6. What are the selling-points of a carpet?

7. What is the difference between a carpet and a tapestry?

8. (*a*) Describe the Axminster carpet.
   (*b*) Name the different kinds of Axminsters.

9. (*a*) How does an Axminster differ from an ingrain?
   (*b*) How does it differ from a Brussels?

10. What is the moquette carpet?

11. (*a*) Describe the Aristo carpet.
   (*b*) Describe the Aubusson carpet.

12. Define the following: carpet binding; carpet lining; carpet warp; carreau; felt carpet.

13. Describe the following: hemp carpet; knitted carpet; list carpet; paper carpet; savonnerie carpet; rug carpet; real carpet.

14. (*a*) Compare tapestry and Brussels.
   (*b*) Describe the difference in manufacture.

15. Describe the following: velvet carpet; velveteen carpet; Wilton carpet.

16. (*a*) What is the difference between a rug and a carpet?
   (*b*) Why are rugs more popular than carpets?

17. Give a short history of the rug.

18. (*a*) Give the history of oriental rugs.
   (*b*) Describe how they are made and state their selling-points.

19. What is the difference between an antique and a modern rug?

20. (*a*) How would you distinguish an oriental rug from a modern rug?
   (*b*) Give the selling-points of each.

21. (*a*) What determines the fineness of an oriental rug?
   (*b*) Can a machine-made rug equal a hand-made rug?
   (*c*) Give the reasons.

22. (*a*) What is a Turkish rug?
   (*b*) Give its history; its uses.

23. (*a*) How may the story of an oriental rug be read?
(*b*) Distinguish the Turkish rug from the Persian rug.

24. Give a short account of the carpet and rug industry in America.

25. Give the selling-points of the following rugs: (*a*) cotton rugs; (*b*) Wilton rugs; (*c*) velvet rugs; (*d*) Axminsters; (*e*) ingrains; (*f*) orientals; (*g*) Brussels; (*h*) chenille.

26. State the selling points of a rug in contrast with those of a carpet.

CHAPTER XXXII

THE SELLING OF TEXTILES

Production is the making of the goods into a form suitable for human use. The farmer raises cotton, picks it, and sends it to the mill to be made into thread or yarn, and then into cloth. All of these steps from the raw material to the finished products enter into production.

Distribution is the transportation of the goods from the place where they are made to the place where they are wanted, and the disposal of them for the use of those whose needs they serve. For example, silk goods are taken from the mills in Paterson, transported to the selling-houses on Fourth Avenue, New York, where they are kept until they are sold to the retail stores, which, in turn, sell by the yard to the customer, who utilizes the fabric.

Consumption is the destruction or using up of the goods when they are made into a fabric and worn out.

Importance of the Textile Industry. The magnitude of the textile industry in the United States is evident when we consider that it gives employment to a round million of people, paying them more than five hundred million dollars annually in wages and salaries, producing nearly one and three-quarters billion dollars in gross

value each year, and giving a livelihood to at least three millions of our population.

Wool, cotton, flax, and silk have been used since early times. Even in the earlier days these fibers were woven with great skill. It is not known which fiber was the first to be used in weaving. It is probable, however, that the possession of flocks and herds led to the spinning and weaving of wool before cotton, flax, or silk fibers were thus used. A knowledge of the history and development of the textile industry makes possible a much better understanding of the phases of production and distribution.

The development of the textile industry may be divided into four stages or periods: first, the *family* system; second, the *guild* system; third, the *domestic* system; and fourth, the *factory* system.

The Family System. Under the family system the work of spinning and weaving was carried on by members of a household for the purpose of supplying the family with clothing. There were no sales of the product. Each class in society, from the peasant class to that of the nobleman, had its own devices for making clothing. This was the system that existed up to about the tenth century.

The Guild System. As communities became larger and cities sprang up, the textile industry became more than a family concern. There was a demand for better fabrics, and to meet this demand it became necessary to have a large supply of different parts of looms. The small weaver who owned and constructed his own loom

was not able to have all these parts, so he began to work for a more prosperous weaver. The same conditions applied to spinning, which in time came to be carried on by a class distinct from the weavers. As a result the small weaver was driven out by the growth of organized capital, and a more perfect organization, called the guild system, arose. By this system the textile industry was carried on by a small group of men called masters, employing two, three or more men (distinguished later as journeymen and apprentices). The masters organized associations called guilds and dominated all the conditions of the manufacture to a far greater extent than is possible under present conditions.

The family system existed in the American colonies at the beginning of the settlement, and for many years after. The guild system was not adopted in America because it was going out of existence on the Continent.

The Domestic Period. By the middle of the 18th century the textile industry began to break away from the guilds and spread from cities to the rural districts. The work was still carried on in the master's house, although he had lost the economic independence that he had under the old guild system, where he acted both as merchant and manufacturer. He now received his raw material from the merchant and disposed of the finished goods to a middleman, who looked after the demands of the market.

The Factory System. The domestic period was in turn followed by the factory system. A factory is a

place where goods are produced by power for commercial use. The factory system first came into prominence after the invention of the steam engine. No record has been found showing its existence prior to this invention.

English weavers and spinners became very skilful and invented different mechanical aids for the production of yarn and cloth. These mechanical aids enabled one man to do twenty men's work, and further utilization was made of water and steam power in place of manual labor. Then began the organization of the industry on a truly gigantic scale, combining capital and machinery and resulting in what is known as the factory system.

Previous to the development of the factory system there was no reason why any industry should be centered in one particular district. Upon the utilization of steam power the textile industry became subdivided into a number of industries, each one becoming to a great extent localized in convenient and suitable portions of the country. Thus in Bradford the wool of Yorkshire (England) meets the coal of Yorkshire and makes Bradford the great woolen and worsted center of the world. A similar thing took place in Manchester, where the cotton of America meets the coal of England under satisfactory climatic conditions, and around Manchester is the greatest cotton manufacturing center of the world.

The same is true in America. Lawrence became a large worsted center on account of the great water

power and the use of the river to deposit wool washings. Lowell, Fall River, and New Bedford became large cotton centers for similar reasons.

Factory Organization. The early mill managers of New England, men like Lowell, began to arrange systematically the processes of manufacturing so that no labor would be lost in passing from one process to another. Since this system was first established, changes have been made. Lowell organized a mill with a president as chairman of the board of directors and a treasurer as the executive head, who had the responsibility of buying the raw material and, through the selling-house, of disposing of the finished product. The mill was separated into a number of subdivisions, such as carding, spinning, warp dressing, weaving, and finishing. Each subdivision was in charge of an overseer and his assistants. A superintendent supervised all the overseers and had charge of the employees and their operations. The mechanic who had charge of the buildings and machinery, as well as the superintendent, reported to a resident agent who acted as general manager for the proprietors. This organization is the best method of operating a textile mill and selling its product. Owing to the fact that each plant specializes in making a particular fabric, the efficiency of the production of textiles is very high. As a rule, the mill employees are of highly specialized workers who tend and supervise machines equipped with devices for automatic action. The great problem of textiles to-day is the rapid distribution of the product to the

consumers. This field of activity is more difficult than production and has not achieved as high a standard of efficiency.

Importance of Distribution. The field of distribution has not received the scientific study that production has received. There are various reasons for this. The most important and the one which most readily suggests itself is that primacy of production occupied the minds of the people to such an extent that the study of distribution has been neglected. Again, the feeling of the people was one of contempt for all concerned in the field of distribution. This last was not entirely undeserved. It was once the custom of the merchant to attempt to get as much as he possibly could from the consumer, without a just regard for the value of the article he was selling. "Let the buyer beware" was the slogan under which the merchant and the consumer met. Still another reason for this feeling, and one which persists even to this day in some instances, was the universal conviction that, since there was no change made in the form of the goods, an increase in price was an unjust imposition.

The tendency of the last few years has changed the uncompromising and uncomplimentary attitude on the part of the public towards the distributing agent. Criticism is aimed, and justly so, at distributive machinery rather than at the merchant. There are several reasons for this favorable change. Productive enterprise has advanced to such an extent that the problem of distribution has been brought to the fore in the

minds of the people. This has given the public a chance to see the middleman in a different light. Another reason is that the merchant, instead of trying to victimize the consumer, as was the custom in the olden days, finds it more to his advantage to protect the consumer, and the latter is beginning to appreciate the necessity of the middleman.

There are to-day several different kinds of middlemen. Some of these have proved themselves unnecessary burdens upon the pocket of the public. One can readily see how much unnecessary expense is added to commodities, because of profits taken by unnecessary middlemen.

An analysis of the field of distribution shows that it is a very important phase of business life. Textiles may pass through the following steps before reaching the consumer: *manufacturer*, *broker*, *commission house*, *jobber*, *retailer*, and *consumer*. Of course it is impossible to eliminate all distributors. To reach the consumer some form of retailing is necessary, — this is true even if the producer sells directly to the consumer, since he must in such circumstances become a retailer himself.

Selling Agent. The selling-house or agent arose from the great demand on the part of the mill for capital for covering the cost of materials in process and finished goods unsold, and for the extension of the necessary credits to customers. This capital was obtained during the early part of the 19th century from merchants who had heretofore invested their capital in an import and export business. Because they had invested their

capital in the mills, they were naturally interested in the disposal of the finished product and became the selling agents of the mills. The selling agent received interest on the capital advanced and commission on the sales of the product. Later the selling agent prepared the designs for the fabrics made and charged a commission of $1\frac{1}{4}\%$. In this case the work of gathering style information is done by an expert, called a styler, who makes fabric designs and their working out as follows: Designs with specifications are sent to the mill, which makes up samples called " blankets," and submits its estimate of the price at which goods can be delivered. The designs are incorporated into the season's lines and the selling-house sends out its salesmen with samples.

Commission Agent. Later the term " selling-house " was changed to " commission house " or " agent " and as both the financial and selling agent became a very important factor in the development of the mills. As financial agents they endorse the notes for the mills to secure money from the banks, and usually charge from 1 to $1\frac{1}{2}\%$. Sometimes they endorse the paper of the buyers so that the mills may secure money from the banks before payment is due, and for this service they generally charge from 2 to $2\frac{1}{2}\%$, — or as much as 6% for seasonal fabrics. Often they cash the sales, deducting the successive discounts from the bills.

During the last few years banks have established textile departments and are willing to advance from 75 to 85% of the net value of the mills' product, taking

title to the goods. The goods are then sold, the bills are issued in the name of the banks, and collections are made by them.

The selling department of the selling or commission house became rather complicated, assuming practically the planning of all the selling operations. In this case the services are divided into three parts: (*a*) designing, (*b*) selling, and (*c*) collecting.

Commission Merchant. In order to sell textiles on a commission basis a district distributor arose, called a commission merchant. This distributor may be an individual or a firm authorized to sell textiles in its own name or in the name of the foreign or domestic manufacturer. This agent is entrusted with the possession, management, control, and disposal of the goods to be sold.

Jobber. Selling agents usually exact very strict terms from the purchaser. Many dealers in textiles are unable to meet quick payments, and consequently they are willing to pay a higher price for textiles provided they receive better terms of payment. Therefore an agent called a jobber has arisen, who buys textiles in bulk from the mills and resells them to smaller dealers at " a higher price, in smaller quantity, and with long-term payments."

Broker. Textile manufacturers often authorize an agent to make a bargain and contract for raw material, unfinished cloth, etc. There are cotton brokers who purchase raw cotton for mills, also cotton brokers who sell raw cotton for the farmer. The same practice

applies to textiles in other conditions, such as cloth, etc. The broker differs from a commission merchant in having less power.

Converter. This term is applied to agents who purchase cloth (either cotton or silk) in the grey, that is, as it comes from the loom. This cloth is finished by the converter; that is, made white (bleached), printed, dyed, etc., according to demands of customers.

Retail Salesman. The final sales of textiles must naturally be in small units. Since most wholesalers tend to specialize, it is natural that there must be some agency that will bring together textiles of all kinds and dispose of them in small quantities. The retail dry goods store has undertaken this task.

Qualification of the Distributor. The success of every distributing agent depends upon his ability to circulate the textiles that he receives; that is, to sell them. The selling agent and commission agent must know the tendency of the styles and of "human wants for textiles" in order to know the textiles that should be manufactured by the mill. In addition, he must know how to sell textiles in large quantities and be able to quote prices in terms of large sales. The same statement applies to the jobber, who acts between the selling agent and the retailer or small manufacturer of clothing. He must know the values of textiles in terms of the needs of the selling trade and the small retailer. The converter must know how to determine the needs of the trade and give directions for finishing cloth. The retailer sells direct to the consumer in small units and

must naturally render to the consumer greater service than any of the other distributing agents.

Buying and Selling. A successful buyer and seller of textiles should have the point of view of the selling and buying public. The buying public have certain needs. The selling public should ascertain these needs by an analysis of the demands and requirements of the consumer within his financial ability. The selling agent should attempt to meet the demands at a reasonable profit above the cost of selling.

The success of all distributing agents depends upon:

(*a*) The ability to determine the needs of the customer and to meet them by offering the proper textiles and service.

(*b*) Being sympathetic with the interests of the customer and trying to win his confidence.

(*c*) Knowing the textiles that he is selling so well that he can answer any question about them, their use, value, and disadvantages.

(*d*) Selling scientifically by bringing out the selling points of the different kinds of textiles and not attempting to sell them by name only.

A successful selling agent of textiles should know the technical side of textiles — their uses, how they are made, the raw materials, yarns, structure, and finish of all fabrics. Hence the need of a knowledge of textiles from fiber to cloth, because the fiber is the foundation, and the qualities of the fabrics depend upon the industrial characteristics of the cotton, wool, silk, etc.

The consumption of textiles is very important to the

SALES DEPARTMENT OF THE SELLING AGENT OF A LARGE MILL

consumer because of the large amount of one's earnings (20% to 33% of the income) often spent on clothing and textile house-furnishings. A saving of 9% or more means that this sum may be used for savings and other purposes. In order to be economical in this respect, it is absolutely necessary for the consumer to know the different kinds and qualities of textiles, the ones best adapted to his use, and how to obtain the greatest service from the fabrics.

Cost of Selling. Very few of the buying public realize the cost of selling. Sometimes it costs as much as 200% above the original mill price to place an article in the hands of the consumer. To illustrate: A yard of gingham cloth may cost at the mill 14 cents and is sold to the retail store for 28 cents. The retail store sells the gingham to the consumer for 42 cents a yard. The mill price for a staple is usually determined by adding from 8% to 10% to the complete cost of manufacturing.

The mill price for a novelty is usually determined by adding 25% to 100% to the complete cost of manufacturing, depending upon the risk involved in selling the whole production of the fabric.

The complete cost of manufacturing includes at least the cost of the raw materials, the cost of the operations in producing the fabric, the cost of financing, depreciation, etc.

There are two methods of calculating profit: (1) considering the selling price as a basis, and (2) considering the buying price as a basis.

Solution: — Method No. 1.

$0.14 mill price
.28 wholesale price
.42 retail price

Cost of selling (wholesale) is 50 % of selling, or 100 % buying price.
Cost of selling (retail) is 33⅓ % of selling, or 50 % buying price.
Retail price is 200 % over original mill price.

Method No. 2

Cost of selling (wholesale) is 100 % of purchase price.
Cost of selling (retail) is 50 % of purchase price.
Retail price is 200 % over original mill price.

It may seem strange that it costs more to sell than to manufacture, but an analysis of the selling problem will show that the above statement is true. It may be well to outline some of the factors in the cost of selling, such, for instance, as planning the campaign of selling:

(*a*) Determining the exact field or market.

(*b*) Finding the most effective system of presenting goods to the public — advertising.

(*c*) An investigation of the financial standing of the buying public.

(*d*) Investment and upkeep of building and equipment of showroom, storage, etc.

(*e*) Expenses and salaries of selling force and assistants.

(*f*) Cost of transportation — freight, trucking, shortage, insurance, etc.

(*g*) Losses due to bad debts, depreciated goods on hand, etc.

(*h*) Accumulation and classification of information relating to the field of manufacturing and destination.

(*i*) Fair profit on capital invested.

The salesman must be trained scientifically in the following:

1. Selling points of the textiles. (Use, characteristics, etc.)
2. Field for product; the developed and undeveloped market.
3. Basis of appeal to the buying public.
4. Determination of price and credit to customers due to difference in locality, competition.

In addition, he must have those personal qualities that will appeal, for a negative personality may often prevent an opportunity of presenting the merits of a textile fabric. The principal steps in making a sale are as follows:

(1) Arouse an interest — show the need of the textile.

(2) Present the good qualities of the fabric.

(3) Suggest a sale of a certain quantity — not too much.

(4) Write the order, stating terms, etc.

Advertising. Advertising is a means of developing a market for goods. In the beginning of this chapter it was shown that any agency can justify itself if it contributes to the increase in circulation of textiles from the mills to the consumer. Advertising is one of the most effective means of arousing the public to the value of textiles and thereby creating a demand for them. Most people do not realize the need until the advantages of a fabric are presented to them.

Advertising also associates the name of a firm with

a textile of a certain kind. In this way the good name or good will of a firm or fabric is established and increases the sales. The association of quality with certain firms is reported from customer to customer and from family to family and becomes part of the assets of a firm and is known as its "good will." The name of the textile becomes the trade name or trademark and may be copyrighted; that is, the United States Government will allow a firm to register at the Patent Office at Washington the name of a textile. If any other firm uses this name it may be prosecuted in the courts and made to pay damages due to loss of sales.

QUESTIONS

1. What is the meaning of the expressions: (*a*) Production of textiles; (*b*) Distribution of textiles; (*c*) Consumption of textiles?

2. State the importance and magnitude of the textile industry in the United States.

3. (*a*) What are the four stages of development of the textile industry?

(*b*) Explain the importance of each stage.

4. At what stage of development did the so-called middleman appear?

5. Describe the advantages of the factory system to the average consumer?

6. Name some of the great textile centers.

7. Which department of textiles has been more thoroughly organized — production or distribution?

8. Name some of the advantages and disadvantages of having the middleman in the field of textiles.

9. Name some of the principal distributing agencies of textiles.

10. Trace the history of the selling house.

11. Explain the difference if any between the (*a*) selling house, (*b*) commission house, and (*c*) selling agent.

12. Explain the function of a styler.

13. How are designs made for woven fabrics (clothing)?

14. How does the mill obtain money to pay wages and to buy raw material?

15. When does the mill receive payment for goods manufactured?

16. Describe the organization of a large selling house and explain the purpose of each department.

17. What is a commission merchant?

18. (*a*) Describe the purpose of a jobber.

(*b*) How can he justify his existence in the distribution of textiles?

19. What is meant by the expressions: (*a*) cotton broker and (*b*) cloth broker?

20. Explain the purpose of the converting department.

21. What is the difference between wholesale and retail selling?

22. If any distributing agents may be eliminated, would it be the wholesale or retail?

23. How can a distributing agent justify his existence?

24. Are textiles ever bought or sold by the name of the manufacturer?

25. Is the purchase by name a reliable method? If so, why?

26. What is meant by buying on merit?

27. Which is more scientific — buying and selling on name or merit?

28. Explain the meaning of the expressions: (*a*) buying public, (*b*) selling public, and (*c*) consumer.

29. Why do people buy?

30. Will the public buy a textile if they do not need it?

31. Will the public buy to meet deferred or future needs and keep the textile in storage until the demand arrives?

32. (*a*) Can you educate the public to have a need for a certain textile, such as artificial furs?

(*b*) If so, how can it be developed?

33. How can a selling agent determine the exact field for a textile; e.g., a pure linen towel?

34. (*a*) Is it possible for a selling agent to sell at an excessive profit?

(*b*) If so, how long can he continue to receive this excessive profit?

35. What constitutes a fair profit on (*a*) staple textiles and (*b*) on novelty textiles.

36. Explain why it costs more to sell than to manufacture a fabric?

37. Why does it cost more to sell at wholesale than at retail?

38. Explain the two methods of calculating the cost of selling an article.

39. State the cost of selling: (*a*) wholesale and (*b*) retail a silk fabric that cost at the mill 89 ¢ a yard; sold at wholesale for $1.80 a yard, and to the consumer for $2.65 a yard?

40. If a staple worsted fabric was sold at the mill price for $1.15, what would you expect the consumer to pay at retail?

41. A silk novelty was sold at the mill price for $2.25; what would you expect the retail price to be?

42. Outline a campaign that you would follow in placing a textile fabric on the market.

43. What is the real purpose of advertising?

44. Do you think all kinds of advertising pay?

45. What is meant by the expression "Good will" of a firm?

46. What is a trade name or a trademark?

47. What is meant by selling-points?

48. What constitute the selling-points of: (*a*) crêpe de Chine; (*b*) taffeta; (*c*) gingham; (*d*) broadcloth.

49. Is it necessary to have different prices for textile fabrics in different parts of the country? If so, explain the reasons.

50. What are the personal qualities of a successful salesman?

51. Enumerate the steps in interesting a customer and closing a sale.

To illustrate the scientific method of purchasing cloth the following specifications are shown: The United States Government desires to purchase a khaki cloth to meet certain requirements at the lowest price. These requirements are incorporated in the specifications and are widely advertised. As a result the government receives bids and contracts for furnishing the fabric. The lowest (reliable) bidder receives the contract. Note that no name of mill or fabric is mentioned. The cloth is purchased on merit and not name.

Specifications for Fabrics

Marine Corps Specifications *Adopted* 13 *August*, 1913.

SUITING, KHAKI, FIBER DYED

Material. — To be made of a good quality cotton, evenly spun, and free from waste, shives, and other impurities.

Weave. — To be four-harness twill, three up and one down, twill running to the left and to be as prominent as possible, 26 to the inch. All yarns to be single. To have two white warp threads woven in each selvage. Cloth to be woven soft, pliable, smooth surfaced, free from all clearly recognizable imperfections, and to contain no more sizing when finished than standard sample. Material must not shrink more than **5** per cent in length or **2** per cent in width.

Color. — To be dyed a uniform color in the raw stock, warp and filling to be same khaki shade, producing in finished cloth the shade shown in standard sample. Material must be fast to laundering, perspiration, urine, and climatic influences such as sunlight, air, and exposure incident to military service.

Width **28** inches. Weight per linear yard not less than **6** ounces. Threads not less than **88** in warp and **54** in filling per inch. Strength not less than **120** pounds in warp and **80** pounds in filling per inch.

Tests. — Following are official tests which will be applied in inspection:

Washing three times with Oleine soap (Marine Corps issue). Material to be thoroughly dried after each wash; soap to be

applied on face of cloth and then completely washed out, using a scrubbing brush in the process.

Boiling for **10** minutes in a solution of soap, **80** grains of ordinary laundry soap to **1** pint of water.

Steeping **24** hours in lactic acid, specific gravity **1.21** U. S. P.

Steeping **24** hours in a solution of citric acid, made by using **3** drams of citric acid to **2** fluid ounces of cold water.

Standing an exposure to the weather (roof test) for **30** days.

A deduction of one-eighth yard will be made for each stain, hole, or imperfection found in the material during the process of inspection after delivery.

To be equal in all respects to standard sample.

Reference:

Letter D. Q. P. to Q. D., 15 March, 1923, 169, (b), 28999.

HEADQUARTERS
U. S. MARINE CORPS,
Washington, D. C.

C. L. McCAWLEY,
Brigadier General,
The Quartermaster.

39146–23

Marine Corps Specifications for Khaki Cloth

CHAPTER XXXIII

TESTING TEXTILE FABRICS

Testing Textile Fabrics. This is an age of adulteration, and next to food there is probably no commodity that is adulterated as much as the clothing we wear. Large purchasers of textile fabrics and various administrative bodies, such as army clothing departments, railway companies, etc., have adopted definite specifications to ensure having good material and workmanship. Before the fabrics are accepted they are examined carefully by certain tests to see if they meet the requirements. Wholesale and retail merchants insist on various conditions when purchasing fabrics in order to conform to the increasing needs of the public. Hence every manufacturer, buyer, or dealer in fabrics should be familiar with the tests used to determine the quality of goods he is about to buy.

The tests used are as follows:

1. Identification of the style of weaving.
2. Testing the breaking strength and the elasticity by the dynamometer.
3. Determining the "count" of warp and filling.
4. Determining the shrinkage.
5. Testing the constituents of warp and of filling.
6. Testing the finish and dressing materials.
7. Testing the fastness of the dye.

Directions for Determining the Style of Weave. In examining a fabric for the weave it is first necessary to determine the direction of the warp and filling threads. This is a very simple matter in a great many fabrics that have a selvedge — the warp must be parallel to the selvedge.

In fabrics that have been fulled, raised, and cropped, as buckskin, flannel, etc., the direction of the nap will indicate the direction of the warp, since the nap runs in this direction.

In the case of fabrics with doubled and single threads, the doubled threads are always found in the warp.

In fabrics composed of cotton and woolen threads running in different directions, the cotton yarn usually forms the warp and the woolen yarn the filling. Then again the warp threads of all fabrics are more tightly twisted than the filling threads, and are separated at more regular intervals.

Sometimes in stiffened or starched goods threads running in only one direction can be seen. In this case they are the warp threads.

If one set of threads appears stiffer and straighter than the other, the former may be regarded as warp, while the rough and crooked threads are the filling. The yarn also gives one a hint, since the better, longer, and higher number material constitutes the warp, while the thicker yarn the filling.

The direction of the twist of the thread is conclusive; if one set has a strong right twist and the other a left twist the first is the warp.

After determining the direction of the warp and filling, the next point is to determine the interlacing of the warp and filling threads — the weave. This may be done by inspection or by means of a pick-glass and needle. The weave may be plotted on design paper (plotting paper), the projecting warp threads being indicated by filling up the corresponding square, and leaving those referring to the filling threads blank. In this way the weaving pattern of the sample is obtained, and serves as a guide to the weaver in making the fabric, as well as for the preparation of the pattern cards for the Jacquard loom.

Testing the Strength and Elasticity of a Fabric. The old-fashioned plan of testing cloth by tearing it by the hand is unreliable, because tearing frequently requires only a certain skilled knack whereby the best material can be pulled in two. In this way an experienced man may tell good from bad cloth, but he cannot determine slight differences in quality, because he has exerted his strength so often that his capacity to distinguish the actual force has disappeared.

The best means of determining the strength of a fabric is by means of a mechanical dynamometer,[1] which expresses the tensile strength of the fabric in terms of weight. The machine is very useful to the manufacturer because it enables him to compare accurately his various products with those of his competitors. The value of these tests is sufficiently proved by the fact that all

[1] The testing apparatus may be obtained from any textile manufacturing company, such as Alfred Suter, 487 Broadway, New York.

army clothing departments, etc., require their supplies of cloth, etc., to pass a definite test for strength.

Breaking tests also afford the most certain proof to bleachers of cotton and linen goods as to whether the bleaching has burned or weakened the goods. The same test will quickly determine whether a fabric has been improperly treated in the laundry.

Determining the Count of Warp and Filling Threads. Every fabric must contain a certain count of warp and filling threads — a definite number within a certain space for each strength of yarn employed. A fabric is not up to the standard of density when less than the requisite number of warp or filling threads per inch is found. For example, if a buyer was told that a fabric is 80 square, that is, eighty warp threads and eighty filling threads to the inch, and on examination found only 72 square, he would immediately reject the goods.

The count of warp and filling is determined by means of a pick-glass — a small mounted magnifying glass — the base of which contains an opening of one-half inch by one quarter inch, or one quarter inch by one quarter inch. If the pick-glass is placed on the fabric the number of warp and filling threads may be counted, and the result multiplied by either two or four, so as to give the number of threads to the inch. For example, if I count twenty picks and twenty threads on a one quarter-inch edge, there are eighty picks and eighty threads to the inch. A more accurate result can be obtained by using a pick-glass with a one-inch opening.

Determination of Shrinkage. A very important factor in the value of a fabric is the shrinkage. The extent of this may be determined by pouring hot water over a sample of about twelve by twenty inches, and leaving the fabric immersed over night, then drying it at a moderate temperature without stretching. The difference in length gives the shrinkage, which is usually expressed in percentage.

Determination of Weight. Buyers and sellers of dry goods, when traveling, are anxious to determine the weight of fabrics they examine. This may be done by means of small pocket balances so constructed as to give the number of ounces to the yard of a fabric.

Testing the Constituents of the Warp and Filling. Take a sample piece of the cloth to be examined — the piece must be large enough to contain specimens of all the different kinds of yarn present in the material — and separate all the filling and warp threads. Be sure that all double threads are untwisted.

Combustion Test; Test for Vegetable and Animal Fibers. Burn separately a sample of the untwisted warp and filling threads. If one or both burn quickly without a greasy odor, they are vegetable fibers, cotton or linen. If one or both burn slowly and give off a greasy odor, they are animal fibers, wool or silk. This test is not conclusive, and further chemical examination — acid test — must be made to ascertain whether wool is pure or mixed with cotton.

Acid Test. The vegetable fibers, cotton and linen, are distinguished from those of animal origin by their

behavior in the presence of acids and alkalies. The vegetable are insoluble when boiled with a 4 per cent sodium hydrate solution, but readily clear or carbonize when saturated with a 3 per cent sulphuric acid solution and allowed to dry at a high temperature in a hot closet. Wool on the other hand is not affected by the action of weak sulphuric acid.

Cotton Distinguished from Linen. If the fibers are vegetable, cotton may be distinguished from linen by staining the fibers with fuchsine. If the fibers turn red, and this coloration disappears on the addition of ammonia, they are cotton, if the red color remains the fibers are linen. Whenever cotton yarn is used to adulterate other fabrics, it wears shabby and loses its brightness. When it is used to adulterate linen, it becomes fuzzy through wear. One may detect it in linen by rolling the goods between thumb and finger. Linen is a heavier fabric, and wrinkles much more readily than cotton. It wears better, and has an exquisite freshness that is not noticed in cotton fabrics.

Silk Distinguished from Wool. Place the fabric or threads containing animal fibers in cold, concentrated hydrochloric acid. If silk is present it will dissolve, while wool merely swells.

Artificial Silk from Silk. On account of the low value of the artificial and the high value of genuine silk, there is a tendency to offer the artificial instead of the pure article. Test: When artificial silk is boiled in 4 per cent potassium hydrate solution it produces a yellow solution, while pure silk gives a colorless solution.

A common test is to put the artificial silk in water, where it will pull apart as though rotten; or to take out one strand of the silk, hold it between the finger and thumb of each hand and wet the middle of the strand with the tongue, when it will pull apart as though rotten.

Artificial silk is inferior in strength and elasticity to pure silk. Then again it is lacking in the crackling feeling noticed in handling the genuine article.

Test for Shoddy. It is no easy matter to detect shoddy in woolen fabrics; the color of the shoddy threads is the best evidence. Many parcels of rags are of one single color, but for the most part they are made of various colored wools; therefore, if on examination of a fabric with a magnifying glass a yarn of any particular color is found to contain a number of individual fibers of glaring colors, the presence of shoddy can be assumed with certainty.

Woolen goods containing cotton are seldom made from natural wool. Shoddy yarns, especially in winter goods, are found in the under-filling at the reverse side of the cloth, as thick, tightly twisted yarns, curlier than those from the pure wool.

Determination of the Dressing. During the various operations of washing, bleaching, etc., the goods lose in weight, and to make up this deficit a moderate amount of dressing or loading is employed. Dressing is not regarded as an adulteration, but as an embellishment.

Various dressing materials are used, such as starch, flour, mineral matters, to give the goods stiffness and feel on one hand, and on the other to conceal defects

in the cloth, and to give a solid appearance to goods of open texture. The mineral substances used serve chiefly for filling and weighting, and necessitate the employment of a certain quantity of starch, etc. In order that the latter may not render the cloth too stiff and hard, further additions of some emollient, such as glycerine, oils, etc., are necessary.

When a fabric filled in this manner is placed in water and rubbed between the hands, the dressing is removed, and the quantity employed can be easily determined.

By holding fabrics before the light dressing will be recognized, and such goods, if rubbed between the fingers, will lose their stiffness. Loading is revealed by the production of dust on rubbing, and by the aid of the magnifying glass it can be easily ascertained whether the covering or dressing is merely superficial or penetrates into the substance of the fabric.

The tests of permanence of dyes on fabrics are as follows:

Washing Fastness. Fabrics should stand mechanical friction as well as the action of soap liquor and the temperature of the washing operation. In order to test the fabric for fastness a piece should be placed in a soap solution similar to that used in the ordinary household, and heated to 131 degrees F. The treatment should be repeated several times. If the color fails to run it is fast to washing.

Fastness Under Friction. Stockings, hosiery yarns, corset stuffs, and all fabrics intended to be worn next

to the skin must be permanent under friction, and must not rub off, stain, or run, that is, the dyed materials must not give off their color when worn next to the human epidermis (skin), or in close contact with colored articles of clothing, as in the case of underwear.

The simplest test is to rub the fabric or yarn on white unstarched cotton fabric. In comparing the fastness of two fabrics it is necessary to have the rubbing equal in all cases.

Resistance to Perspiration. With fabrics coming in contact with the human skin it is necessary in addition to fastness under friction that they should withstand the excretions of the body. The acids of perspiration (acetic, formic, and butyric) often become so concentrated that they act on the fiber of the fabric.

In order to test the fabric for resistance, place the sample in a bath of 30 per cent dilute acetic acid (one teaspoonful to a quart of water) warmed to the temperature of the body, 98.6 degrees F. The sample should be dipped a number of times, and then dried without rinsing between parchment paper.

Fastness against Rain. Silk and woolen materials for umbrella making, raincoats, etc., are expected to be rainproof. These fabrics are tested by plaiting with undyed yarns and left to stand all night in cold water.

Resistance to Street Mud and Dust. Ladies' dress goods are expected to withstand the action of mud and dust. In order to test a fabric for this resistance the sample should be moistened with lime and water (10

per cent solution), dried, and brushed. Or sprinkle with a 10 per cent solution of soda, drying, brushing, and noting any changes in color.

Fastness to Weather, Light, and Air. Various people have attempted to set up standard degrees of fastness — for every shade of color is affected by the action of sun, light, and air — and as a result fabrics that remain without appreciable alteration for a month of exposure to direct summer sunlight are classified as "fast," and those undergoing slight appreciable change under the same conditions as "fairly fast." "Moderately fast" colors are those altering considerably in fourteen days; and those more or less completely faded in the same time (fourteen days) are designated as "fleeting."

Directions for testing fastness of Color in Sunlight. Cover one end of the sample of cloth with a piece of cardboard. Expose the fabric to the sunlight for a number of days and examine the cloth each day in the dark and notice whether the part exposed has changed in color when compared with the part covered. Count the number of days it has taken the sunlight to change the color.

Brown in woolen materials is likely to fade. Brown holds its color in all gingham materials.

Dark blue is an excellent color for woolens and ginghams. Light blues on the other hand usually change.

Black, gray, and black with white. These colors are very satisfactory for woolen materials.

Black is not a color which wears very well with cotton fabrics, as it shows the starch (sizing) and often fades.

Red is an excellent color for all woolen materials. It looks attractive and wears well.

USEFUL TABLES

How to Find Weight of Warp and Weft. In order to find the weight (in pounds) of warp yarn in a cloth, multiply the number of ends per inch by the width (in inches) of the cloth and multiply the result by the length (in yards), of warp yarn. This total is to be divided by the number of yards in a hank multiplied by the counts of the yarn.

For finding the weight of the weft (in pounds), multiply the number of picks per inch by the width of warp (in inches), at the reed, the result to be multiplied by the length (in yards), of woven cloth. The total is to be divided by the number of yards in a hank multiplied by the counts of weft. Often an allowance of 4 to 7 per cent is made for waste in finding weight of weft.

Conditioning. The process by which the percentage of moisture is determined in textiles is called conditioning. A certain percentage of moisture (called regain) is necessary for the proper strength of the textiles and is given in the following table:

	Bradford [1] regain	Roubeux [1] regain	Internat'l [1] regain	Philadelphia [1] regain	U. S. government regain
Wool	16	14.25		13.6	
Wool waste	16	14.25		13.6	
Tops, combed with oil	19	18.25	18.25	13.6	
Tops, combed without oil	18.25	18.25		13.6	
Noil, ordinary	14				
Noil, clean	16				
Woolen yarn		17	17	11.1	
Worsted yarn	18.25				
Cotton yarn	8.5		8.5		
Silk yarn	11				
Woolen or worsted cloth	16			9.9	11
Silk			11		
Linen			12		
Hemp			12		
Jute			13.75		

[1] Different locations and centers.

How to find Counts of Folded Yarn. In order to find the counts of the folded (two ply, three ply, etc.) yarns, the individual counts of the component threads are multiplied and then divided by the added total of the same counts.

The same rule applies when the singles of the folded yarn are alike or different in size.

Find Count of Yarn From Small Sample of Fabric. An easy way to find the count of yarn (in case only one kind has been used either in the warp or in the filling) is to cut the warp, or the filling, into certain lengths; the number of these short lengths necessary to weigh one grain will give the count of the warp, or of the filling, in that particular fabric.

These lengths, into which the yarn is to be cut, are: 4.333 inches for cotton and spun silk, 1.543 inches for linen and woolen, 2.88 inches for worsted.

Find Number of Yards of Cloth Per Pound. In order to find the number of yards of a given cloth contained in a pound, the count (number) of the average yarn in the cloth is multiplied by 840 in cotton fabrics and 560 in wool cloths (minus the customary 10 per cent allowance for contraction). The result is divided by the product of the warp ends and fillings within an inch multiplied by the width (in inches) of the cloth.

Find Weight of Cotton Cloth. In case small quantities of a cotton cloth are available the following rules will give the cloth weight:

When one square inch of cloth (made of one count of yarn only) is available, divide 7000 by the product of the width of the cloth (in inches), the weight of the available piece (in grains), and 36; the result shows the number of yards in a pound. This rule holds good for larger pieces with the difference that for two square inches of cloth 14,000, for three square inches 21,000, for four square inches 28,000, etc., are to be taken as the number to be divided.

For cotton cloth made of different counts of yarn the number of yards contained in a pound can be figured by multiplying 194.4 by the number of square inches available of the cloth and divide the result by the multiplication of the width of the cloth (in inches) and the weight (in grains) of the available piece.

If 16 is divided by the number of yards per pound the result will show the number of ounces per yard of cloth.

The weight of the cloth in ounces per square yard can also be figured directly from a small piece available by multiplying the width of the cloth (in inches), by 36 times the weight (in grains) of the available small piece and divide the result by the multiplication of the number of square inches by 425.

Find Average Count in Cloth. To find the average count of all the yarns entering into a cloth, the sum of the number of warp ends and picks in an inch of material is divided by a sum obtained by adding the quotients of the warp ends divided by the count (size) of same ends and the number of picks divided by the count (size) of same picks.

Find Average Number of Yarn for any Required Cloth. The count of yarn needed to weave a certain desired cloth is figured in the following manner: The sum of the warp ends and picks in an inch is multiplied by the number of yards of the required cloth in question contained in a pound and this is multiplied by the width of the fabric in inches. The result is to be divided by 840 in cotton and 560 in wool cloth. This rule applies to fabrics not weighted (sized), and from 7 to 10 per cent allowance should be made for shrinkage.

Find What One Pound of Raw Cotton Will Make. In order to give one an idea of how much cloth can be obtained from one pound of raw cotton the following data is offered: 25 handkerchiefs, or 56 spools of No. 40 sewing thread, or $1\frac{1}{2}$ yards of denim, or 4 yards of muslin, or 6 yards of gingham, or 7 yards of calico, or 10 yards of lawn.

Purchase of Raw Silk. Raw silk is purchased by American silk manufacturers through an agency, Chinese or Japanese, in order to facilitate transit. The silk is purchased according to grades — quotations are furnished each day. The fineness of the silk is expressed in deniers which is the weight of 450 meters of silk expressed in denier units (of .05 grams). That is, if 450 meters of silk weigh 8 grams or 16 deniers (.05 grams), the fineness is expressed as 16 deniers. The size is usually written 16/18, which means between 16 and 18 deniers. The weight of Chinese and Japanese silk is expressed in mommies, a definite weight. There

are approximately 120½ mommies in 1 pound, therefore 7½ mommies equals 1 ounce. A four mommie cloth is about a half ounce.

Artificial silk is sold according to grade, condition of bleach, and size expressed in deniers, as shown by the following:

Prices quoted by the Viscose Company are as follows:

300 Denier

Grade A — Bleached	$2.65
Grade B — Bleached	2.45
Grade C — Bleached	2.35

150 Denier

Grade A — Bleached	$2.80
Grade B — Bleached	2.60
Grade C — Bleached	2.40

Silk is sold according to quotations issued from day to day as follows:

Yokohama

Double Extra Special Crack, for single weaving	white 13/15 denier	Dec. 11 $8.55
Double Extra A	"	8.45
Double Extra B	"	8.40
Strict Extra	"	8.35
Extra	"	8.30
Best No. 1 to Extra	"	8.25
Best No. 1	"	8.20
Strict No. 1	"	8.15
No. 1	"	8.10

Canton

XXA Crack New Style 14/16	$7.90
XXA Favorite New Style 20/22	7.40

Shanghai

Steam Filature Anchor Soy Lun grade and No. 1	$9.00
Tsatlee "Blue Dragon" — "Flying Horse" (six choices)	7.10
Black Lions, 1 and 2	6.75
Tussah, Eight Cocoons, "Black Pagoda" grade Nos. 1 and 2	5.00

Milan

Extra Classical	$8.60
Fair Extra Classical	8.30
Best Classical	....

Spun Yarns (Domestic)

	2% 10 days
6/2	$4.15
10/2	4.25
30/2	4.65
20/2	5 00
40/2	5.25
50/2	5.35
60/1 (net weight of silk)	4.55
60/2	5.50

Schappe Yarns (Imported) Best Grades

100/1 (Net weight of yarn) Gray	$4.65
100/1 Gray (net weight of yarn) second quality	4.40
100/1 (Net weight of yarn) White	4.75
200/2 Gray (skeins) first quality	5.80
200/2 Gray (skeins) second quality	5.55
200/2 White (skeins) first quality	5.65
200/2 White (skeins) second quality	5.90

(On account of the rapid fluctuations in exchange, schappe prices are only approximate.)

EXPERIMENTS[1]

Experiment 1 — Construction of Cloth

Apparatus: Pick glass, dissecting pin, foot-rule.
Materials: 4 square inches of burlap.
References: *Textiles.* See page 70, Weaving; page 1, Fibers.

Directions

1. Look at the cloth under the pick glass and describe the appearance and structure of its interlacing threads, called *weave.*

2. With a pin separate the interlacing threads of the cloth which are called *warp* and *filling.* *Warp* is composed of yarn running in the direction of the length of the cloth. *Filling* is composed of yarn running at right angles to the warp.

   a. What are the interlacing threads of cloth called?

   b. Of what is warp composed and in what direction do the warp threads extend? filling?

3. Notice the appearance of the individual threads (called *yarn*) of the warp and filling. Test the strength of the yarn by trying to break it.

4. Untwist one of the warp threads and one of the filling threads. Notice whether the yarn becomes stronger or weaker as it is untwisted. What effect has twist on the yarn?

5. After untwisting one of the threads what remains? Measure the length of several of these ends called *fibers.* Describe the appearance of the fiber as to curl, feel, fineness, etc.

Questions

1. Of what does yarn consist?
2. What causes the fibers to cling together?
3. What is the process called by which two sets of threads interlace?

[1] Dissecting pin may be made by placing head of pin or needle in a pen holder.

4. When two sets of threads interlace or are woven what is produced?

Experiment 2 — Plain or Homespun Weave

Apparatus: Hand loom,[1] two pencils, scissors.
Material: Yarn of two colors.
Reference: *Textiles*, page 73.

Directions

1. Make a warp on the hand loom with green yarn by having parallel threads running the longest way of the loom to the notches.

2. A *harness* is a framework on a loom used for raising certain warp threads. Use a pencil as a harness and raise the 1st, 3d, and 5th warp threads. A *shed* will in this way be formed through which the shuttle carrying the filling thread will pass. Use the red yarn for filling and attach it at one end before passing it through the shed.

3. With a second pencil to act as a second harness raise the 2d, 4th, and 6th warp threads. Pass the filling through the shed thus formed.

4. Repeat twice Directions 2 and 3.

5. Tie all ends, cut the woven sample away from the loom, and mount in note-book.

Questions

1. What part of a loom is the harness?
2. What is meant by a shed?
3. What carries the filling thread through the shed on a loom?
4. What is the principle of plain weaving?
5. Name some fabrics produced by plain weaving? See *Textiles*, page 58.

Experiment 3 — Twill Weave

Apparatus: Hand loom, four pencils, scissors.
Materials: White cotton warp, colored yarn filling.
Reference: *Textiles*, page 76.

[1] A hand loom consisting of simply a square frame, may be obtained from Hammett & Co., Devonshire Street, Boston, Mass.

Directions

1. On the hand loom make a warp by threading four white warp threads to a notch until there are six sets of warp threads.
2. Using a pencil as a harness (See Exp. 2) raise the first thread of each set of warp threads and pass the filling thread through the shed thus formed.
3. With another pencil as a second harness raise the second thread of each set of warp threads and pass the filling.
4. With a third pencil raise the third thread of each set of warp threads and pass the filling.
5. With still another pencil to act as a fourth harness raise the fourth thread of each set and again pass the filling.
6. Repeat the above directions (2 to 5) several times. Notice that the moving of the filling thread, one warp thread to the left, each time it is woven is causing a diagonal line or rib to form, called *twill.*
7. Cut the woven sample away from the loom and mount.

Questions

1. Why is this weave called a twill weave?
2. How is the diagonal line or twill formed?
3. Why would this kind of weaving be spoken of as 4-harness weave?
4. What popular dress fabric is of twill weave?

Experiment 4 — Comparison of Plain and Twill Weave

Apparatus: Pick glass, dissecting pin, foot-rule.
Material: 4 sq. in. of burlap, 4 sq. in. of serge.
References: *Textiles*, pages 73, 76, 80.

Directions

1. Examine the burlap under the pick glass, noting the structure and number of threads to the inch in the warp (called *ends*) and the number of threads to the inch in the filling (called *picks*). Verify with foot-rule.
2. Repeat the above, using serge.

Questions

1. What is meant by a number of "ends to the inch"? a number of "picks to the inch"?
2. How many ends to the inch in the burlap? How many picks to the inch?
3. How many ends to the inch in the serge? How many picks?
4. Note several differences between cloth produced by plain weaving and cloth produced by twill weaving.

Experiment 5 — Pile Weave

Apparatus: Hand loom, two pencils, scissors.
Materials: White cotton warp, filling yarn of two colors.
Reference: *Textiles*, page 89.

Directions

1. Thread the loom two warp threads to a notch until there are 20 ends (warp threads).
2. Use a pencil as a harness. Raise the 1st, 3d, 5th, 7th, and 9th sets of warp threads.
3. Fasten securely the green filling yarn at one end and pass it through the shed formed by carrying out Direction 2. Draw the filling thread tight and wind once or twice around the outside warp end.
4. Use a second pencil as a harness and raise the sets of warp threads that are now down, forming a new shed.
5. Fasten the red filling yarn at one end and pass it through the shed. Wind once or twice about the outside warp end.
6. Raise the red filling to form a loop in each place where it (the red filling) has passed over a warp end.
7. Form a shed by raising the first harness and pass through the green filling thread, drawing it tight to hold the red filling above it in place. Wind about the outside warp end.
8. Repeat Directions 2–7 several times, each time raising the red filling to form loops and each time drawing the green filling tight to hold the red in place.
9. Cut with scissors the loops formed by raising the red filling.

10. As well as you can with scissors, shear the pile (the soft, thick covering on the face) to make a fairly even surface.

11. Cut the sample away from the loom and mount.

Questions

1. What are some varieties of cloth that are woven with a pile surface?

2. Sometimes the loops of the pile are cut and sometimes left as loops. What fabrics are examples of cut pile? uncut pile?

3. What is meant by the *pile* of velvet or carpet?

Experiment 6 — Other Classes of Weave

Apparatus: Pick glass, dissecting needle.
Materials: Samples of satin, voile, lace curtaining, double cloth, carpeting.
Reference: *Textiles*, pages 73 and 90.

Satin Weave

1. Examine the sample of satin under the pick glass. Notice that the warp and filling interlace in such a way that there is no trace of the diagonal on the face of the cloth.

a. Is satin of a close or loose weave?

b. What can you say of the surface of satin?

c. What effect has this smooth surface on light?

d. This is called a satin weave. Why?

e. What is the most extensive use of the satin weave? (See *Textiles*, page 79.)

NOTE. — Sometimes fabrics of other weaves will have a satin stripe.

Gauze Weave

2. Examine the sample of voile under the pick glass. This is a type of what is known as gauze weave.

a. What is the chief characteristic of the gauze weave?

b. Name several gauze fabrics.

Lappet Weave

3. Examine a piece of lace curtaining under the pick glass.

a. If the fancy figures were not present, of what weave would this sample be?

Simple figures are stitched into plainly woven or gauze fabrics by machinery to imitate embroidery. This style of weave is known as lappet weave.

b. On fabrics of what two weaves is lappet weaving used?

c. What is lappet weaving?

Jacquard Weave

4. Examine a piece of carpet. Notice the elaborate designs or patterns and the number of colors used. When the figures are elaborate they cannot be stitched in by simple lappet weaving. A special attachment called the *Jacquard* apparatus is placed on top of the loom. This apparatus controls the warp threads so that a great many sheds may be formed and elaborate figures woven into fabrics. This is called Jacquard weaving.

a. What must be added to a loom for Jacquard weaving?

b. What is the use of the Jacquard apparatus?

c. When is the Jacquard weave used instead of lappet weave?

5. Read *Textiles*, page 82.

Double Cloth Weave

6. Examine the sample of double cloth. Notice that there are two single cloths. They are combined into one by here and there lacing the warp and filling of one cloth into the warp and filling of the other. In this way they are fastened together securely.

a. What color is the sample on one side? the other?

b. Of what is double cloth composed?

c. How are the single cloths combined into one?

d. Read *Textiles*, page 86. What are some of the uses of double cloth?

Classes of Weave

7. How many classes of weave have been studied?

8. Name the classes of weave.

9. Name a fabric to illustrate each weave.

Experiment 7 — Fibers

Apparatus: Pick glass, dissecting needle.
Materials: Samples of broadcloth, mohair, silk, cotton cloth, linen.
References: *Textiles*, pages 1; 169, Mohair; 312, Silk; 185, Cotton; 392, Linen, 410, Jute; 412, Ramie; 412, Pineapple.

Directions

1. Read *Textiles*, page 1, paragraph 2. What are textiles?
2. Cloth is composed of yarn. Yarn in its turn is composed of many small ends called fibers.
3. Look at the sample of broadcloth. If you did not know this to be broadcloth you would speak of it as woolen goods. Detach from the sample a filling thread and separate it into fibers. These are woolen fibers.
4. Examine the sample of mohair and separate a filling thread into fibers. This takes the name mohair from the fibers which compose it. Mohair is obtained from the Angora goat.
5. Examine a sample of silk, also a detached filling thread. The silk fiber consists of a thread spun by the silk worm.
6. Wool, mohair, and silk fibers are obtained from the animals, the sheep, goat, and silk worm, hence they are called animal fibers.
7. Detach from the sample of cotton cloth a filling thread and separate it into fibers. These are cotton fibers and are obtained from the cotton plant.
8. Examine the sample of linen, a filling thread and its fibers. Linen is composed of fibers obtained from the flax plant.
9. Cotton and linen fibers are obtained from plants, and are called vegetable fibers. There are other vegetable fibers such as jute, hemp, ramie, pineapple, etc., but cotton and linen are the most important.
10. Name the most valuable fibers for textile use.

Questions

1. Of what is cloth composed?
2. Of what does yarn consist?

3. How are the fibers made to join in one long thread? (See Experiment 1.)
4. Of what fibers are woolen and worsted goods composed?
5. Of what animal is wool the covering?
6. Of what fibers is mohair composed?
7. From what animal is mohair obtained?
8. Of what does the silk fiber consist?
9. What are the animal fibers?
10. Why are they called animal fibers?
11. Of what fibers is cotton cloth composed?
12. From what plant are cotton fibers obtained?
13. From what plant is the linen fiber obtained?
14. What are the most important vegetable fibers?
15. Name four other vegetable fibers.
16. Why are these fibers called vegetable fibers?

Experiment 8 — Wool Fiber

Apparatus: Pick glass, microscope, 2 pine cones, foot-rule.
Materials: Raw wool, woolen yarn.
Reference: *Textiles*, chapter ii.

Directions

1. Separate a strand of woolen yarn into fibers. Examine both these fibers and fibers pulled from the raw wool. Would you describe these fibers as coarse or fine?
2. How do the fibers feel to touch?
3. Test the strength of the wool fibers by trying to break them.
4. Measure the length of several fibers.
5. Why was it difficult to straighten the fibers to measure them?
6. Extend the fiber to its full length, then release. How does this prove the fiber to be elastic?
7. Examine the fibers under the microscope. Describe. Notice that the wool fiber is cylindrical in shape. Notice that it is covered with scales which overlap much as do the tiles of a roof or the spines of a pine cone.
8. Hold one pine cone with the spines pointing upward. With the spines of the other pointing downward press the second cone

down on the first. What happens? Just so the scales or points of the wool fibers hook into one another and interlock. These scales or serrations give to the wool fiber its chief characteristic which is the power of interlocking known as *felting* or *shrinking*.

9. See *Textiles*, page 2, the drawing of a magnified wool fiber. Make a drawing of a wool fiber.

10. Examine under the microscope a hair from your head. Wool is only a variety of hair. Notice that the scales on the hair lie close to the stem and do not project as in the woolen fiber, hence hair fibers cannot interlock as wool fibers do. The scales lying close to the hair give a smooth surface to the fiber and make luster a characteristic.

11. Compare the wool fiber with hair, noting two differences.

Questions

1. With what is the wool fiber covered?
2. Of what advantage are these scales or points?
3. What is the chief characteristic of wool?
4. What is meant by the shrinking or felting power?
5. Name five characteristics of the wool fiber.

Experiment 9 — Mohair Fiber

Apparatus: Microscope, foot-rule.
Materials: Wool fibers, mohair fibers, sample of mohair brilliantine.
References: *Textiles*, pages 1, 22, 169.

Directions

1. Pull a mohair fiber from the fleece. Hold it up to the light. Describe the fiber as you see it.

2. Hold a mohair fiber and a wool fiber side by side to the light. Note the differences.

3. Measure several mohair fibers.

4. Examine the mohair fiber under the microscope. The fiber is covered with scales, but they lie close to the fiber and do not project in points as do the scales on the wool fiber, hence mohair will not felt to any degree.

5. The Angora goat of Asia Minor furnishes the mohair. This goat is being raised in the western states of the United States now.

6. Detach from the sample of mohair brilliantine a warp thread; a filling thread. Which is mohair? Which is cotton?

7. What word would describe the feel of mohair brilliantine? the appearance?

8. What are the characteristics of the mohair fiber?

9. What are the uses of mohair? Mohair is used in the manufacture of plushes, dress fabrics, and imitation furs.

Questions

1. Why will mohair not felt as wool does?

2. The scales lying close to the stem will have what effect on the surface of the fiber?

3. What effect will a smooth surface have on light?

4. What characteristic is given to mohair from the fact that the smooth surface reflects light?

5. From what animal is mohair obtained in greatest quantity?

6. Where is mohair being grown in the United States?

Experiment 10 — Cotton Fiber

Apparatus: Microscope, foot-rule.
Materials: Tuft of cotton fibers, cotton ball, seeds.
Reference: *Textiles*, chapter xii, page 185.

Directions

1. Hold a tuft of cotton fibers tightly between the fingers and thumb of each hand and pull apart with a jerk. What is your judgment of the strength of the *staple* (fiber)?

2. Loosen gently the fibers of one of the tufts you have pulled apart. What is the feel of cotton? the appearance as you hold it to the light?

3. Detach several fibers one by one. How does the length compare with that of the wool and mohair? Measure and record the length of three fibers.

4. How do cotton fibers compare in fineness with wool fibers?
5. Compare the elasticity of cotton with that of wool.
6. Examine the cotton fibers under the microscope. Observe that the enlarged fiber looks like a twisted ribbon. When the fiber was growing it was cylindrical in shape. When ripe the plant drew back its life-giving fluid from the fiber and it collapsed and twisted like a corkscrew. The twist is peculiar to the cotton, being present in no other fiber. The twist makes the cotton fiber suitable for spinning, helping to hold the short fibers together.
7. Read of the cotton plant from *Textiles*, chapter xii.
8. The four chief cotton producing countries are the United States, Egypt, India, Brazil.
9. There are several classifications of cotton. The most common are Sea Island (in the lead); Egyptian (a close second); Uplands (that of the United States, southern part); and Peruvian.
10. Uplands is the most common cotton of our South.

Questions

1. What characteristic causes the cotton fiber to be easily recognized under the microscope?
2. Why does the twist render the cotton fiber suitable for spinning?
3. What are the characteristics of the cotton fiber?
4. Why is cotton known as a vegetable fiber?
5. Name the chief cotton producing countries.
6. What are the most common classifications of cotton?
7. What is the finest growth of cotton? (Sea Island commands at the present time $1.00 a lb., while Middling Uplands brings 15 cents.)
8. Where is cotton known as Upland Cotton grown?

Experiment 11 — Silk Fiber

Apparatus: Tripod, alcohol lamp, small pan of water, lead pencil.
Material: Silk cocoon.
Reference: *Textiles*, chapter xvi, page 312.

Directions

1. Place the cocoon in a small pan of water. Apply heat to the pan until the water boils. The cocoon is placed in hot water to soften the glue which holds the fibers together.

2. Remove the outside loose fibers which cannot be reeled. This tangled silk on the outside of the cocoon is called *floss*.

3. Brush the finger over the cocoon to find the loose ends. Unwind carefully until you find a continuous end. Wind or *reel* the silk fiber over a lead pencil.

4. The silk fiber is the most beautiful and perfect of all fibers.

5. Hold the cocoon to the light as you reel. How does the silk fiber compare in fineness with the wool and cotton fibers?

6. The silk fiber is from 1000 to 4000 feet long. Unlike the other fibers the silk fiber is already a thread.

7. How does light effect the silk fiber? When the gum is thoroughly washed off the silk takes on its luster which is its chief characteristic.

8. Break the fiber after you have reeled a small quantity. Notice how the fiber springs back. Extend and release again. What characteristic does this illustrate?

9. Examine the silk fiber under the microscope. Notice that it is round and smooth and resembles a glass rod. It shows what appear to be two fibers united by the gum secreted at the same time that the fiber was formed. Describe the silk fiber as it appears under the microscope.

10. Silk is taken from the reel and twisted into a skein of raw silk and thus exported.

11. The manufacture in the United States begins with raw silk. It is handled here first by the *throwster* who winds it from the skein and makes different varieties of thread.

Questions

1. Why is the silk cocoon first placed in hot water?
2. What is known as floss?
3. What is meant by silk reeling?
4. What can you say of the length of the silk fiber?
5. In what way does the silk fiber differ from the other fibers?

6. What is the chief characteristic of the silk fiber?
7. What are other characteristics of the silk fiber?
8. In what form is silk exported?
9. In what countries is most of the raw silk produced? (See *Textiles*, page 312.)
10. With what does the silk manufacture in the United States begin?
11. Who is the *throwster* and what is his work?

Experiment 12 — Linen Fiber

Apparatus: Microscope.
Material: Flax fibers.
Reference: *Textiles*, chapter xviii, page 392.

Directions

1. The linen fiber is obtained from the flax plant. Certain fibers, such as flax, jute, and ramie, are obtained from the stem of the plant, hence are known as *bast* fibers, and flax is the most important bast fiber.
2. It is difficult to separate the flax or linen fiber from the woody part of the stem. The process is called *retting*, which is really rotting by soaking the stem in water.
3. Before the fibers are entirely free from the woody part of the plant they undergo the processes of beating, breaking, scutching, hackling, etc.
4. Read the account of each process. See *Textiles*, pages 393–398.
5. Measure and record the length of two linen fibers.
6. Test the strength by trying to break the fiber.
7. Test for elasticity.
8. What is the appearance of the linen fiber when held to the light?
9. What is the color of the fiber? What is the process called by which linen is whitened? (Bleaching.)
10. Examine the flax fibers under the microscope. Observe that the fibers look like long cylindrical tubes. Describe the appearance of linen fibers under the microscope.
11. The best flax is grown in Belgium and Ireland.

Questions

1. From what part of the plant are bast fibers obtained?
2. Name some bast fibers.
3. What is the most important bast fiber?
4. What is retting?
5. For what purpose is linen subjected to retting?
6. Through what five processes does the flax fiber pass before it is free?
7. Where is the best flax grown?

Experiment 13 — Carding

Apparatus: A pair of hand cards.
Material: Small quantity of scoured wool.
References: *Textiles*, pages 61 and 205.

Directions

1. Examine the hand cards. Notice that there is a foundation of several layers of leather. Notice that this foundation is covered with staples of steel wire. Notice that the staples are shaped like the letter U with the points turned one way. The covering of the hand cards is called *card clothing*.

2. Hold one hand card in the left hand, face up, wires pointing to the left. Spread the wool over the pointed wires of this card.

3. Hold the other card in the right hand, face down, with the wires pointing to the right. Bring the pointed wires of this card down on the wool and drag it lightly through the wires of the other card. Repeat several times.

4. You have been *carding* wool. The sharp points have been tearing the wool apart or disentangling the fibers. Carding brushes the fibers out smooth and makes them somewhat parallel. It forms them into a thin sheet.

5. The wool must be carded many times before it is sufficiently disentangled for drawing and spinning. In order to card again the hand card must be *stripped* of the wool so that it may be dragged again through the staples.

6. Hold the hand card, which is in your right hand, erect. Notice that the wires point downward. Move the other hand

downward over the wires. Notice that the surface is smooth. The points do not prick as they will if you try to brush the hand upwards over the wires.

7. Hold the card in the left hand in a similar position. Raise and bring the sharp wires of this card down on the smooth surface of the other card and strip it of its wool.

8. Card again, then strip again. Repeat several times until the fibers are thoroughly disentangled.

9. This carding and stripping, once done by hand, is now done in the mill by a power machine called the *card*. (See picture, *Textiles*, page 43.) Notice that instead of cards this machine consists of rollers or cylinders. Some are carding cylinders and some are stripping cylinders. The principle is the same as that of the hand cards. The wool is carded and stripped again and again and is finally delivered in a soft, fluffy rope called a *sliver* ready for drawing and spinning.

Questions

1. What is the covering of the hand card called?
2. Describe card clothing.
3. What does carding do to the wool?
4. When the sharp wires of one cylinder meet the sharp pointed wires of another cylinder what is the action on the wool?
5. If the sharp points of one cylinder meet the smooth surface of another cylinder what happens to the wool on that cylinder?
6. In what form does the wool finally leave the machine? What name is given to this fluffy rope?
7. How was carding done in the early days? How is it done now?
8. In what way is the principle of the hand cards the same as that of the card of the mill?

Experiment 14 — Drawing and Spinning

Apparatus: Foot-rule, elastic band.

Material: Small quantity of scoured wool.

References: *Textiles*, pages 50, 56, 208; Sections: Spinning: Mule Spinning.

Directions

1. Observe the mass of wool fibers. The wool was clipped from the sheep, *washed*, and *oiled* to make it smooth and pliable.

2. With the fingers gently open up or loosen the mass of wool fibers. In the mill this is done by a machine called the *card*. (See picture, *Textiles*, page 43.) And the process itself is called *carding*.

3. Gently *draw* out the mass of fibers until you have drawn it into one long strand.

4. Draw it again and again until to draw it would cause it to break.

5. This process in the mill is known as *drawing*. The wool passes through machine after machine, which gradually reduces the thickness of the strand.

6. You have now a strand called *roving*, but not a thread with which you could weave. What is called the strand? Why could you not weave with it as it is? If you pulled the roving apart it would separate into a number of small ends. What name is given to these ends?

7. It is necessary to hold these fibers together in a thread. Hold the roving in the left hand and with the right hand draw the fibers out several inches. As you draw, twist the roving between the fingers and thumb. The *twisting* is called *spinning*.

8. When you have twisted sufficient yarn to attach to the end of a foot-rule, do so. Give a whirl to the ruler, which is taking the place of the old-time *spindle*, and let it drop. Continue to whirl the ruler and notice that as it revolves the yarn is twisting. When well twisted, wind the yarn on the ruler. There was a hook on the old-time spindle. Instead of the hook, hold the wound yarn in place by an elastic band. Draw out several inches again and repeat.

9. With the spindle a *distaff* was used. It held the roving which you now hold in your left hand. (See picture of distaff and spindle.)

10. Define spinning; see *Textiles*, page 11, footnote. The early use of the spindle was the same as its use of to-day. In what two ways is the spindle of use?

11. The improvement on the distaff and spindle was the spinning wheel. Now the spinning frame in the mill has replaced both.

Questions

1. After shearing, through what two processes does wool pass?
2. Why is it necessary to oil wool?
3. What is the work of the *card?*
4. Explain the process called *drawing.* Why is it necessary to repeat the operation several times?
5. What followed the distaff and spindle in the development of spinning?
6. On what is the spinning done now in the mill? See *Textiles,* picture, pages 213, 215.

Experiment 15 — Gilling and Combing

Apparatus: Coarse comb, fine comb.
Material: Small quantity of scoured wool.
Reference: *Textiles,* pages 46–50.

Directions

1. Open up the wool a little with the fingers. Do this in place of carding, as you need but a small quantity.
2. You comb your hair to make the hairs lie parallel, side by side, in place. Combs are used on wool for just the same purpose, but the first process of combing is not known as such. It is called *gilling,* and the combs themselves are called *fallers.* The machines are known as *gill boxes.* See *Textiles,* page 49.
3. Hold the carded wool in the left hand in the middle of the strand. With the coarse comb in the right hand, comb and thus straighten the fibers first at one end then at the other. This is *gilling.* The principle of gilling is to comb the fibers more and more nearly parallel and to draw them out into more even strands.
4. The coarse comb causes the hairs to lie parallel. A fine comb will further straighten the hairs, but it will also remove the snarled, tangled, short hairs. Again wool is to be treated like hair. Hold the strand in the middle as before. Comb each end with the fine comb. Notice that the fine comb is removing the short fibers and leaving the long fibers between the fingers. This is the second process of combing, and is called *combing.*
5. The long fibers are called *tops* and the short fibers are known

as *noils*.[1] Combing is the process which separates the long fibers known as *tops* from the short fibers known as *noils*.

6. The combing machine in the mill is a very complicated one. See picture, *Textiles*, page 47.

7. Gill and comb several strands of wool.

8. Top is too delicate, as it comes from the comb, to be handled. The next process is to combine several strands into one. Combine the several strands you have gilled and combed. Comb this one end with the coarse comb again to be sure that the fibers are perfectly parallel.

9. You gilled, combed, and gilled again. So it is in the mill. After combing, the wool is gilled again by machines known as *finisher gill boxes*, and wound into a ball called *a top*.

10. *A top* differs from *top*. *Top* is the strand of long fibers which comes from the comb. *A top* is the ball of combed wool as it comes from the finisher gill boxes. It weighs from 7 to 12 lbs. and contains 200 to 250 yds.

11. The wool is now ready for the next processes — those of drawing and spinning.

Questions

1. Why is the hair combed? Why is wool combed?
2. What is the first process of combing called? What name is given to the combs used in gilling? What are the machines called?
3. What is the principle of gilling?
4. How does a fine comb act on the hair?
5. When you combed the wool with the fine comb what happened?
6. What are the long fibers called? the short? Of which are there more?
7. What is the second process of combing called?
8. Why is it necessary to combine several strands of top into one end?
9. Why is it necessary to gill again after combing?
10. In what form does the wool finally leave the finisher gill boxes?
11. What is a top?

[1] In the case of linen the short fibers separated by combing are called *tow*, and the long fibers *line*.

12. What two processes follow carding?
13. For what two processes is wool now ready?

Experiment 16 — Raw Wool to Yarn

Apparatus: Hand cards, coarse and fine combs, pencil.
Material: Scoured wool.
Reference: The preceding experiments.

Directions

1. This wool has already been subjected to the three operations of shearing, scouring, and oiling.

2. Card the wool. What does carding do to the wool?

3. Strip the cards. Rub the sheet of fibers between the palms of the hands into the form of a strand. It is in this form that it leaves the card of the mill, and it is known as a *sliver* of wool.

4. Pull about three inches of wool from the sliver and perform upon it the operation of gilling by combing it with the coarse comb.

5. Follow the gilling by the operation of *combing*, which you will do by combing again, this time with a fine comb.

6. Pull about three inches again from the sliver. Continue to gill and comb by section until the entire sliver has been gilled and combed.

7. Combine several strands into one and subject the one strand to a second process of gilling to make sure that all fibers are side by side.

8. Gently draw out this strand of combed long fibers known as top. As you draw, spin. As you spin, wind on a lead pencil. The fineness of the yarn depends on the amount of drawing and twisting.

9. What is the source of wool? You began with wool, covering of the sheep's body, and after subjecting it to a series of operations you have converted it into yarn which is ready for weaving.

10. Name the operations in order, through which raw wool passes before it finally becomes yarn.

Questions

1. What are the first three processes through which wool passes? What is shearing? scouring?
2. Why is wool oiled?
3. What is meant by a sliver of wool?
4. What does gilling do to the wool?
5. What does combing do to the wool?
6. Why is there another operation of gilling after combing?
7. What is meant by *drawing? spinning?*
8. What name is given to the wool wound on the pencil?
9. On what does the fineness of the yarn depend?

Experiment 17 — Difference between Woolen and Worsted Yarn

Apparatus: Pick glass.
Materials: Sample of woolen cloth and worsted cloth.
References: *Textiles,* pages 45 and 46.

Directions

Take a piece of worsted fabric and separate a piece of yarn from either the warp or filling. Do the same with a piece of woolen fabric. Notice the appearance of each piece of yarn. Which is smoother? What effect would friction have on the worsted yarn? the woolen yarn? Which sample of yarn would shine and reflect the light?

Experiment 18 — Burling and Mending

Apparatus: Chalk, scissors, dissecting pin, needle, pick glass.
Material: 4 square inches of cloth from the loom.
Reference: *Textiles,* page 128.

Directions

1. Cloth from the loom is far from being a finished product. It must pass through several processes before it is finished. These processes are known as *finishing.*
2. What is the feel of this cloth?

3. Hold the cloth to the light and look through it. Note the imperfections and chalk them. What defects did you notice?

4. Place the cloth on the desk, face down. Rub the fingers over the back of the cloth. When the fingers locate a knot, raise it with the dissecting needle to be cut off later.

5. Reverse the cloth. Rub the fingers over the face. When a knot is found, force it through to the back with the dissecting needle. All the knots are on one side now. Clip them off with the scissors. This is called *burling* and is the first process of finishing.

6. Hold the cloth to the light. Notice where an entire filling thread is missing. This is known as a *full miss pick*. When part of a filling thread is missing it is spoken of as a *half miss pick*. In general what does a miss pick mean?

7. Unravel a filling thread from the lower edge of the cloth. With it thread a needle and replace the missing pick. Follow the weave closely, using a pick glass as an aid. You are performing the second process of finishing, that of mending.

8. If a warp end is missing replace it.

Questions

1. What is meant by *finishing?*
2. What is the first process of finishing? What is burling?
3. What is a full miss pick? a half miss pick?
4. What is the second process of finishing? What is mending? Of what must the mender be careful?

Experiment 19 — Removal of Stains

Material: Stained fabrics.

Textiles are easily stained, therefore it is necessary to know something about the character of stains and the methods of removal. Stains may be roughly divided into the following classes:

a. Stains from foods, such as grease and fruit acids.
b. Stains from machinery, as wheel grease and oils.
c. Blood stains.
d. Inks.
e. Chemicals, such as acids, alkalies.

Food stains are usually due either to grease contained in soup,

meat, milk, etc., or to sugar contained in candies or preserves, or to fruit acids contained in fresh fruits or sauces.

Wheel grease and lubricant stains are obtained from various parts of machines, like elevators, street cars, etc. After the cloth leaves the loom it often contains spots of grease, oil, or dirt stains due to drippings from the loom or overhead machinery. These are removed by means of liquids called solvents that dissolve the stain. Ether is the principal solvent used in the mill to remove small stains.

Very few people realize that vapors of cooked food and fat, unless carried out of a house, will condense and settle on fabrics in the form of a film which collects a great deal of dust. (A bad grease spot usually has a neglected grease spot for a foundation.) In order to break up this film it is necessary to separate the entangled dust. This is performed by some mechanical means, such as shaking and brushing.

The most effective method of removing a stain is to place a circle of absorbent material[1] around the spot to take up the excess of liquid. A white cloth should be placed under the fabric to absorb the solvent and show when the goods are clean. Then apply the solvent with a cloth of the same color and texture (satin is excellent as it does not grow linty) and rub from outside the spot to the center to prevent spreading. It is necessary to rub very carefully as excessive rubbing will remove the nap and change the color. One of the great dangers in removing a stain is that you may spoil the fabric. Therefore great care must be exercised.

The principal solvents are ether, chloroform, alcohol, turpentine, benzene, and naphtha. Each solvent may be used to best advantage on certain fabrics.

The commercial grades of the solvents often contain impurities

[1] Absorbents are substances that will absorb readily excess of liquids; they include varieties of chalk, paste of chalk, or fullers' earth, rough surface of a visiting card, buckwheat flour, crumbs of bread, powdered soapstone, pumice, whiting. These substances are used to great advantage in assisting to remove stains from delicate fabrics. They absorb the excess of solvent and thus prevent it from spreading.

that leave a brown ring after evaporation. This brown ring is very objectionable. Turpentine is used only in removing stains from coarse fabrics. Chloroform, benzene, and naphtha are used on ordinary silks and linens. Ether and chloroform are used to best advantage in removing stains from delicate silk, as they seldom effect colors and evaporate very quickly. Of course it must be borne in mind that when a stain is removed from a fabric that portion that contained the stain loses some coloring matter and feels rougher than the other part.

Grease Spots on Heavy Goods that cannot be Laundered

It is usually desirable to use the following method in removing grease from a heavy fabric, such as carpets or colored fabrics. In case the grease is fresh, place over the stain a piece of clean blotting paper or a piece of butcher's brown wrapping paper and underneath absorbent paper or oil cloth, and then press the spot with a warm iron. As heat often affects the shades of certain colors such as blues, greens, and reds, it is best to hold a hot iron over the fabric and see if the grease is melted.

Remove a stain from a piece of carpet.

Removal of Grease and Blood

Ordinary Fabrics (wash goods). Wash the fabric containing grease or blood stain with tepid water and soap.

Delicate Fabrics. As strong soap will spoil some colors and textures it is necessary to apply a solvent when a delicate fabric is stained.

Remove stains from a washable fabric and a delicate fabric.

Removal of Wheel Grease and Lubricants on Fine Fabrics

Wheel grease is a mixture of oils and graphite. Apply benzene to the wheel grease spot. This will dissolve the oil, leaving the coloring matter (graphite) on the cloth, and this may be collected on the white cloth on the other side.

Remove a wheel grease stain from a dress fabric.

Removal of Acids

Fruit acids and all others, except nitric acid may be removed by putting ammonia on the spot. This will neutralize the acid, forming a salt which may be either brushed or washed off. In the case of nitric acid the fibers of the cloth are actually destroyed and no amount of ammonia will restore the original condition of the fabric.

Remove a stain of orange juice from a dress or shirt waist.

Removal of Blood

Blood stains may be removed from a fabric by washing with cold or tepid water. Never use hot water, as hot water coagulates the albumen of the blood. After removing the blood soap and warm water may be used. In case the fabric is a thick cloth, the blood may be removed by applications of moist starch.

Take different samples of fabrics and soil them with fruit acids, soup, wheel grease, ink, and blood and remove them. Exercise great care so as not to leave a mark or remove the coloring.

Remove blood from a fabric.

Questions

1. What is a solvent? an absorbent?
2. What is the best solvent to be used in removing stains from silks, coarse goods, and linens? from delicate silks?
3. Why is a brown ring often left after removing a stain?
4. How may grease and blood stain be removed from wash goods?
5. What is wheel grease? How may it be removed?
6. How will ammonia remove acid stains?
7. Does it remove all? Why not?
8. Explain the method of removing blood stain from cloth.

Experiment 20 — Dyeing Wool

Apparatus: Large porcelain dish or casserole, filter.

Materials: Undyed piece of woolen and worsted fabric, undyed yarn, and undyed raw cloth.

Reference: *Textiles*, page 113.

Directions

1. Prepare a solution of coloring matter by dissolving a half ounce of diamond dye (green or red) in a quart of water. Filter the solution. Place a piece of white woolen cloth in the liquid and boil ten minutes. Then wash the dyed fabric and notice whether the dyestuff washes off or not.

2. Repeat the experiment, using the same weight of undyed woolen yarn. Repeat with worsted yarn.

3. Repeat the experiment using the same weight of wool sliver.

4. Notice which has the deeper color. The degree of color depends on the amount of twist in yarn. Which sample has absorbed the greatest amount of dyestuff from the liquid?

a. Why is a yarn-dyed fabric faster than a piece-dyed?

b. Why is a raw stock dyed fabric better than piece or yarn dyed?

Experiment 21 — Dyeing Cotton

Apparatus: Porcelain dish, filter stand, etc.
Material: Piece of cotton cloth.
Reference: *Textiles*, page 115.

Directions

1. Prepare a solution of coloring matter by dissolving a half ounce of logwood in a quart of water. Filter the solution. Place a piece of cotton cloth in the liquid and boil ten minutes. Then wash the dyed fabric and notice whether the dyestuff washes off or not.

2. Repeat the same experiment and use a piece of cotton cloth that has been previously washed in common alum.[1] Note the effect. Which has the greater attraction for dyestuffs, cotton or wool? Why is alum used?

3. Repeat the same experiment, using first the same weight of

[1] Alum in this case is called a mordant, which is a substance that will impregnate the cloth with something which will hold the coloring matter. Other mordants are oxides, hydroxides, and basic salts of aluminum, iron, tin, and chromium.

cotton yarn and then the same weight of cotton sliver. Notice the results.

Which piece of cotton holds the dye best, that which was dipped in alum or the one that was simply boiled in the solution?

Experiment 22 — Weighting Silk. — Affinity of Metallic Salts for Silk

Apparatus: Porcelain dishes.
Material: Silk yarn.
Reference: *Textiles*, pages 327–329.

Directions

1. Weigh separately two skeins of dry silk and distinguish skein No. 1 by looping some cotton thread into it. Prepare a tepid bath containing 10 gm. strong sumach extract in 400 cc. water. Enter the skeins of silk and work for 15 to 20 minutes, meanwhile slowly raising the temperature to about 150° F. Remove, squeeze, rinse with water, squeeze, and dry skein No. 1 for weighing.

2. Meanwhile prepare another bath containing 4 gm. of copperas (ferrous sulphate) in 400 cc. cold water. Work skein No. 2 in bath for 10 minutes cold. Remove, and rinse well; save the iron bath. Repeat the treatment in the sumach and iron baths several times more, finally wash the sumach iron skein in 1 per cent hot soap solution; rinse, squeeze, and dry. Weigh each dried and cooled skein and note the increase in weight of each. Save sample for Experiment 23 and note the effect of weighting on the yarn.

Experiment 23 — Dyeing Silk

Apparatus: Porcelain dish, filter stand, etc.
Material: Piece of silk yarn.
Reference: *Textiles*, page 323.

Directions

1. Prepare a solution of coloring matter by dissolving a half ounce of logwood in a quart of water. Filter the solution. Place a piece of silk skein, from Experiment 22, in the liquid

and boil ten minutes. Then wash the dyed silk and notice whether the dyestuff washes off or not.

2. Repeat the same experiment using the same weight of silk yarn without weighing it. Compare the results?

Experiment 24 — Test to Distinguish Piece-Dyed from Yarn-Dyed Fabric

Apparatus: Pen knife.
Materials: Woolen and cotton fabrics.
Reference: *Textiles*, pages 113–116.

Directions

Unravel threads of the suspected sample, and with a blade of pen knife note whether the dyestuff has penetrated through the yarn as noted by the depth of color in the interior of the yarn. In case there is the same depth of color in the interior as on the surface, the fabric is yarn-dyed. If on the other hand, the interior of the yarn is not so highly colored as the exterior, it is piece-dyed.

Questions

1. What is meant by yarn-dyed fabric?
2. What is meant by piece-dyed fabric?
3. How may the two be distinguished?

Experiment 25 — Test to Distinguish Dyed from Printed Fabrics

Apparatus: Knife-blade.
Materials: Cotton fabrics.
Reference: *Textiles*, page 112.

Printed fabrics may be distinguished from dyed by observing the back side of the cloth, and noting whether or not the pattern on the face of the cloth penetrates through to the back, or only the outline shows. In case the pattern is on both sides of the fabric, take one thread of the sample, and with a knife-blade attempt to scrape off the coloring on the surface of the thread. If the dyestuff has penetrated into the interior of the thread, it is *not* printed.

Questions

1. In printed fabrics is the pattern clearly discernible on the back of the cloth?
2. If the fabric is printed on both sides, how may this fact be proved?
3. What is the difference between printed and dyed fabrics?

Experiment 26 — Bleaching by Sulphur Dioxide

Apparatus: A quart bottle.
Material: Sulphur, worsted or silk fabric.

Bleaching powder cannot be used in bleaching animal fibers such as woolen and silk fabrics. It injures the fibers and at the same time leaves them yellow.

Animal fibers are best bleached by immersing in an aqueous solution of sulphurous acid or exposing them to fumes of burning sulphur.

Wet a piece of dyed worsted or silk fabric and hang it in a quart bottle containing fumes of burning sulphur.[1] The fumes of burning sulphur have an affinity for coloring matter — dyestuff. The fumes (called sulphur dioxide) do not in most cases destroy the coloring matter as chlorine does, but simply combine with it to form colorless compounds which can be destroyed. The color can be restored by exposing the bleached fabric to dilute sulphuric acid.

Questions

1. Why is it necessary that the fabric be moist in order to be bleached by sulphur dioxide fumes?
2. What becomes of the coloring matter?

Experiment 27 — Bleaching by Bleaching Powder

Apparatus: Porcelain dish.
Material: Piece of calico.
Reference: *Textiles*, page 235.

[1] Place a piece of sulphur on a deflagrating spoon and light it by placing it in the flame and allow it to burn. Cover the bottle by means of a glass plate.

Directions

Place a quarter of an ounce of bleaching powder in a quart bottle containing a pint of water.[1] Then place a piece of calico in the water containing the bleaching powder. What is the effect on the calico? Then remove cloth to another bottle filled with dilute hydrochloric or dilute sulphuric acid. What is the effect on the color? Then wash the whitened cloth thoroughly in water.

Why is it necessary in practice to pass cotton fabrics through two baths in bleaching? What is contained in the first bath? in the second bath?

Experiment 30 — Determining Style of Weave

Apparatus: Pick glass.
Materials: Different fabrics.
References: *Textiles*, pages 72–74, etc.

Examine different samples of cloth and classify them according to the seven standards given on pages 72–74, etc.

Experiment 31 — Determining the Size of Yarn

Apparatus: Yard stick.
Materials: Sample of cotton, woolen, and worsted yarns.
References: *Textiles*, pages 54, 62, 63.

As yarns used in the manufacture of fabrics are of all degrees of thickness, it became necessary to adopt some method of measuring this thickness. For this purpose yarns are numbered, so that when the number is known an idea of the size of the yarn may be gained. It would seem advisable to number yarns of all kinds

[1] Bleaching powder is prepared by passing chlorine gas over layers of slaked lime (lime to which a slight amount of water has been added). Bleaching powder bleaches by having its hypochlorous acid set free, which in turn gives up oxygen, being converted into hydrochloric acid. The French use solutions containing chloride and hypochlorite of soda. They are called Labarraque's disinfecting fluid. A similar solution of a mixture of chloride and hypochlorite is called Eau de Javelle.

according to one fixed standard, yet unfortunately this is not done. The methods of counting yarns are many and varied. The usual method is to estimate the yarn number by taking the number of hands of a definite length which make up some given weight. Thus in the worsted yarn, No. 1 is a yarn that has 560 yards to a pound. No. 2 worsted yarn has two times 560 yards to a pound. How many yards in No. 12 worsted yarn? How many yards in No. 20 cotton yarn?

Experiment 32 — Test for Twist in Yarn

Apparatus: Test dial.
Material: Piece of yarn.
References: *Textiles*, pages 210–212.

As the amount of twist in yarn determines its strength, it is necessary to know the amount of twist per inch in given yarn. The strength increases up to a certain limit. When this limit is reached, increased twist does not make the thread any stronger. We may also have twist and strength at the expense of bulk. The test consists in finding out the number of turns per inch, and this is done by an arrangement where a certain length of yarn is stretched between two points on a twisting machine and the twist taken out. The number of turns required to take the twist completely out are registered on a dial at the side of the apparatus.

Poor cotton that goes into coarse goods cannot be spun as fine as the finer cotton. The shorter the cotton the more twist is required to spin it, and the more twist that is put into the yarn, the less will be the yardage. Whereas on the finer and longer cotton there will be less twist put into it, and the yarn will be much stronger. Find the twist in different kinds of yarn.

Experiment 33 — Determining the Direction of Warp and Filling

Apparatus: Microscope.
Materials: Silk, cotton, and woolen fabrics.
Reference: *Textiles*, page 679.

When one examines a fabric the first thing to do is to determine the direction of the warp and direction of the filling.

Fabrics with Selvedge. — Examine any fabric with a selvedge and notice that the warp threads run in the same direction as the length (longest side) of the selvedge. What direction will the filling threads bear to the selvedge?

Fabrics with a Nap. — Examine a piece of flannel and notice the direction of the nap. Why will the direction of the nap be the same as the direction of the warp? Remember the way in which the fabric enters the napping machine.

Fabrics Containing Double Threads. — Examine a fabric containing double and single threads and notice that the warp contains the double threads. Why?

Fabrics Containing Cotton and Woolen Yarn. — Examine a fabric containing cotton and woolen threads running in different directions and notice that the cotton threads form the warp. Why?

Another way to tell the warp threads in a fabric is to examine warp and filling threads very closely and notice which set contains the greater twist? Why? See if they are separated at more regular intervals. Why?

Stiffened or Starched Fabrics. — Examine stiffened or starched goods very closely and notice the threads. If only one set can be seen they are the warp threads. The stiffer and straighter threads are found in the warp. Why? The rough and crooked threads are seen in the filling.

Experiment 34 — Determining the Density of a Fabric

Apparatus: Pick glass.
Materials: Samples of cloth.
Reference: *Textiles*, page 679.

Directions

1. Examine different samples of cloth and determine the number of filling threads and warp threads by means of a pick glass.
2. Then examine different priced fabrics of the same kind and see whether the low or high priced fabric has the greater density.

Experiment 35 — Determining Weight

Apparatus: Balances, die.
Materials: 4 square inches of cloth.
Reference: *Textiles*, page 680.

Directions

1. Fabrics are bought and sold by the yard. In order to express the amount of wool or cotton in a fabric the weight in ounces per yard is usually given.

2. In order to find the number of ounces per yard a piece of cloth of definite size, usually about 4 sq. in., is stamped out by means of a die, or cut by means of a tin plate exactly 4 sq. in. (2 in. on the side). This is then weighed on very accurate balances and expressed in grains. Find the weight per yard. Remember 7000 grains equal 1 lb.; 16 oz. equal 1 lb.

Experiment 36 — Determining Shrinkage

Apparatus: Hot water.
Material: Sample of woolen fabric.
Reference: *Textiles*, page 680.

Directions

1. Take a sample of a woolen fabric 12 in. by 20 in. and pour hot water over it and leave it immersed over night. Then dry it in the morning at a moderate temperature without stretching. Then measure its length and divide the difference in lengths by the original length. The quotient multiplied by 100 will give the per cent of shrinkage.

2. Repeat the same experiment with a worsted fabric, and with a cotton fabric.

3. Why does the woolen fabric shrink more than the worsted?

Experiment 37 — Test of Fastness [1] of Color under Washing

Apparatus: Porcelain dish, soap solution.
Materials: Cotton and woolen fabrics.
Reference: *Textiles*, page 683.

[1] A description of shoe and hand clothing may be obtained from *Shoemaking* published by Little, Brown & Co., Boston.

Directions

1. Colored goods and printed fabrics should withstand the action of washing. They require more care than white goods and should be soaked in cold water containing very little soap and no soda. They should be dried in the shade as a very hot sun will fade them. If it is necessary to dry them in the sun be sure that they are dried wrong side out, as direct sunlight fades them about five times as much as reflected light.

2. All colored fabrics should stand mechanical friction as well as the action of soap liquor and the temperature of the washing operation. In order to test the fabric for fastness a piece should be placed in a soap solution similar to that used in the ordinary household, and heated to 131° F. The treatment should be repeated several times.

3. If the color fails to run it is fast to washing.

Questions

1. Why should more care be exercised in washing colored goods than white?

2. How may colored fabrics be tested to show that they stand the action of soap solution?

3. Does a moderately warm temperature (131° F) affect the fastness of colored fabric?

Experiment 38 — Test of Fastness of Color under Friction

Apparatus: Yarn, white unstarched cotton fabric.
Materials: Fabrics worn near the skin.
Reference: *Textiles*, page 683.

Directions

Stockings, hosiery yarns, corset stuffs, and all fabrics intended to be worn next to the skin must be closely knitted to withstand friction and must not rub off, stain, or run, that is, the dyed materials must not give off their color when worn next to the human epidermis (skin), or in close contact with other articles of clothing, as in the case of underwear.

In order to test two fabrics to see which is the better, it is nec-

essary to rub the fabric or yarn on white unstarched cotton fabric.

In comparing the fastness of color of two fabrics it is necessary to have the rubbing equal in all cases.

Questions

1. What is meant by friction?
2. What is meant by the expression "fastness of color of two fabrics"?
3. How may the fastness of a colored material be tested to withstand friction?

Experiment 39 — Test of Fastness of Color against Rain

Apparatus: Water, undyed yarn.
Materials: Silk and woolen fabrics.
Reference: *Textiles*, page 684.

Directions

Silk and woolen materials for umbrella making, raincoats, etc., are expected to be rainproof. These fabrics are tested by plaiting with undyed yarns and left to stand all night in water. Notice whether the color of the fabric has run into the undyed yarns.

Take a sample of the fabric and shake some drops of water on it. Notice whether it loses its luster when the drops have dried. Spotting may be prevented by placing a damp cloth on the wrong side of the material; roll the two together, and when evenly damp, unroll and press through the damp cloth with a fairly hot iron.

Place a piece of the fabric in the sun so that the sun and rain may come in contact with it. Notice whether it loses its color and becomes gray and dull.

Experiment 40 — Test of Fastness of Color in Sunlight

Apparatus: Cardboard.
Materials: Silk, woolen, and cotton fabrics.
Reference: *Textiles*, page 685.

Directions

Cover one end of the sample of cloth with a piece of cardboard. Expose the fabric to the sunlight for a number of days and examine the cloth each day and notice whether the part exposed has changed in color when compared with the part covered. Count the number of days it has taken the sunlight to change the color. Does direct sunlight have any effect upon colored fabrics? Which is the most affected by the sun, silk, woolen, or cotton fabrics, dyed with same dyestuff, in the same length of time? Are fabrics changed any sooner by the sun than by the weather?

Experiment 41 — Test of Fastness of Color to Weather, Light, and Air

Materials: Cotton, silk, and woolen fabrics.
Reference: *Textiles*, page 685.

Directions

Examine various fabrics for fastness to weather, light, and air by placing samples outside of a window so that they will be exposed to the weather, light, and air. Have duplicate samples of the above away from the weather and light. Compare the samples exposed to the weather with those in the house and note the number of days it takes to change. Classify the fabrics. Which of the fabrics are most easily affected by the weather, light, and air?

Experiment 42 — Test of Fastness of Color against Street Mud and Dust

Apparatus: Porcelain dish, lime, and water.
Materials: Cotton, silk, and woolen fabrics.
Reference: *Textiles*, page 684.

Ladies' dress goods are expected to withstand the action of mud and dust. In order to test a fabric for the resistance, the sample should be moistened with lime and water (10 per cent solution), dried, and brushed. Or sprinkle with a 10 per cent solution of soda, drying, brushing, and noting any change in the color.

a. Is there any change in color after the lime water has been removed from the cloth?

b. With what may the action of the lime water or soda be compared?

Experiment 43 — Testing Rubberized Fabrics

Materials: Rubberized fabrics.

A great many rubberized fabrics are used for hospitals, domestic purposes and for clothing. On account of the high price of excellent rubberized fabrics a great many substitutes are placed on the market that are satisfactory to the eye, but have not the wearing qualities for the service they are intended to render.

Strength and Resistance to Scratching. — In order to test a rubberized fabric to see if it has the necessary strength to stand everyday use, see if it is possible to scratch it with the finger nail. Then crease it and crumple it between the hands. Then spread it out very carefully and notice whether there are any broken places. If there are it should be rejected.

Waterproof Qualities. — A rubberized fabric should be waterproof. A sample may be tested by forming a bag with it and filling it with water. Crumple the bag while it is filled with water. Notice whether it cracks or leaks.

Examine various rubberized fabrics and notice whether they are substantial.

Experiment 44 — Test for Vegetable and Animal Fiber

Apparatus: Acid, fire.
Materials: Warp and filling threads of cotton and woolen fabrics.
Reference: *Textiles*, page 680.

Directions

One of the most useful tests is to see whether an article is made of wool, cotton, or silk, and if a composition of two or more materials, to estimate the percentage of each. Practical experience can teach one much in this respect, and in many cases inspection is quite insufficient. A more reliable test is to burn a piece of material and notice how it burns.

Take a sample of a woolen and cotton fabric; separate the warp and filling and untwist one piece of warp and one piece of filling yarn. Burn a piece of untwisted yarn and notice whether it burns slowly and curls up into a black crisp cinder leaving a disagreeable smell, or burns with a flash leaving a light ash behind.

Questions

1. Describe the burning process.
2. What is the burning test for vegetable fiber?
3. What is the burning test for animal fiber?

Repeat the same experiment, placing the untwisted yarn in sulphuric acid. Apply heat and note the effect.

What is the acid test for vegetable fiber?

What is the acid test for animal fiber?

Examine different fabrics to see whether they contain vegetable or animal fibers.

Experiment 45 — Difference between Cotton and Linen Fabrics

Examine a real linen towel and a cotton towel. Wet your hands and use both towels to dry them. Notice which of the fabrics absorbs the moisture quicker, or which towel dries the hands better.

Compare a cotton table-cloth and a linen table-cloth. Notice that the linen fabric has a natural gloss, a cool, smooth feel, and launders much better than cotton. The cotton fabric on the other hand gives off a fuzz, and irons dull and shapeless.[1]

Linen is tough and strong, cool feeling, and has a long fiber. Linen cannot be given a cotton fabric finish.[2]

[1] In Ireland the cost of producing a pound of bleached linen cloth 4 sq. yd. is 16*d*. or 32 cts.; cost of hackling a pound of flax is $\frac{1}{2}d$. or 1 ct. per lb.; cost of preparing and spinning a pound of flax is 6*d*. or 12 cts. per lb.; cost of winding and weaving a pound of flax is $2\frac{1}{2}d$. or 5 cts. per lb.; cost of bleaching and finishing a pound of flax is 7*d*. or 14 cts. per lb.; $75 is spent in turning $100 worth of flax into yarn; $75 is spent in turning $100 worth of yarn into brown linen; $50 is spent in turning $100 worth of brown linen into linen for market.

[2] A linen fabric can be best told from cotton by holding it up to the light and examining the evenness of the threads. Cotton can be more

Cotton on the other hand has a weak, short fiber, dull, warm, and non-absorbent. After washing, cotton resembles a limp rag while linen retains firmness and stiffness.

Which fabric absorbs the moisture more readily?

What is the difference in appearance between the two fabrics? Between the fibers of the fabrics?

Experiment 46 — Test to Distinguish Artificial Silk from Silk

Apparatus: Porcelain dish, potassium hydrate.
Material: Piece of silk fabric.
Reference: *Textiles*, page 681.

Since silk fabrics, particularly hosiery, are becoming popular, various attempts have been made to produce substitutes for real silk. To test a silk fabric, boil the sample in 4 per cent potassium hydrate solution and note the effect. If it produces a yellow solution it is artificial silk, if colorless it is pure silk.

Another simple way used by some workmen, although unhygienic, is to unravel a few threads of the suspected fabric, place them in the mouth, and masticate them vigorously. Artificial silk will soften under the operation and break up into a mass of pulp. Natural silk will retain its fibrous strength.

Test various samples of cheap "silk" hosiery.

Experiment 47 — Test to Distinguish Silk from Wool

Apparatus: Porcelain dish, hydrochloric acid.
Material: Silk or woolen fabric.
Reference: *Textiles*, page 681.

easily spun level than flax, therefore threads that present considerable irregularities may be taken to be flax. In a union fabric the nap is usually cotton and the threads more regular than the filling (flax). The best linen is made from fine and fairly regular threads; common linen from coarse and irregular tow yarns. Linen is no more subject to weak places in weaving than cotton, although it is harder to bleach and may be weakened in this process. If each operation is not perfect the linen will become yellow in storage.

Silk may be distinguished from wool by putting the suspected thread or fabric into cold concentrated hydrochloric acid. If silk is present it will dissolve, while wool merely swells.

Test various samples of silk and wool.

Experiment 48 — Test to Distinguish Cotton from Linen

Apparatus: Fuchsine, ammonia.
Materials: Cotton and linen fabrics.
Reference: *Textiles*, page 681.

Directions

1. On account of the high price of linen various attempts are made to pass cotton off for linen. While it is possible sometimes to detect cotton by rolling the suspected fabric between the thumb and finger, the better way is to stain the fabric with fuchsine. If the fibers of the fabric turn red, and this coloration disappears upon the addition of ammonia, they are cotton; if the red color remains, the fibers are linen. The most reliable test is to examine the fiber under the microscope and note the difference in structure.

2. Test a cheap *linen* fabric for cotton.

3. When cotton yarn is used to adulterate linen it becomes fuzzy through wear, and when used to adulterate other fabrics, it wears shabby and loses its brightness. Linen is a heavier fabric, and wrinkles much more readily than cotton. It wears better, and has an exquisite freshness that is not found in cotton fabrics.

4. Describe a chemical test for linen.

5. What is the difference in appearance and wearing qualities of cotton and linen?

Experiment 49 — Test of Fabric to Withstand Ironing and Pressing

Apparatus: Hot iron.
Materials: Silk, cotton, and woolen fabrics.

Directions

Place the sample over an ironing board and iron it with hot iron (about 200° F). Compare the sample immediately with one

not ironed. Remember that many colors, particularly colored silks, change while they are hot. If the original shade returns when the fabric has cooled, then the fabric is fast to ironing and pressing.

Questions

1. What is the object of ironing and pressing clothes?
2. Is it a good plan to press clothes often?
3. Is there any difference in the effect of the hot iron on the three kinds of fabrics?

Experiment 50 — Test of Fabric to Withstand Perspiration

Apparatus: Porcelain dish.
Materials: Silk, cotton, and woolen fabrics.
Reference: *Textiles*, page 684.

Directions

1. In addition to withstanding the action of coming in contact with the human skin, fabrics like hosiery, etc., should withstand the excretions of the body.

2. To test a fabric for resistance, place the sample in a bath of dilute acid made by adding one teaspoonful of acetic acid to a quart of water warmed to the temperature of the body, 98.6° F. The fabric should be dipped a number of times, and then dried, without rinsing, between parchment paper.

Questions

1. What is the effect of the acid solution upon the fabrics?
2. Would they necessarily withstand the effect of perspiration, even if they did withstand the acetic acid solution? Why?

Experiment 51 — Test for Determining Dressing

Apparatus: Magnifying glass, porcelain dish.
Materials: Various fabrics.
Reference: *Textiles*, page 683.

Directions

1. A great many cotton fabrics such as muslin often contain considerable sizing or dressing. In order to examine a fabric

and determine whether too much dressing has been used, take a small sample of the fabric and crush it in the hand and rub it together, so that the dressing is removed and the quantity employed may be determined. If much dressing has been used, dust will be produced in rubbing. Prick the surface with your finger nail. Notice whether the starch comes off. Then wet your finger and rub it on the cloth and allow it to dry. Does the gloss disappear?

2. Another method is to hold the sample before the light and notice whether you can recognize the dressing. Examine the sample with a magnifying glass (or pick glass) and notice whether the dressing is superficial or penetrates the substance of the fabric.

3. Would you buy low priced cotton goods with a thick gloss and pasty look?

4. Notice the effect (lusterless) of fabrics containing much dressing after washing.

5. A very simple way for telling the amount of loading or weighting in a cotton fabric is to weigh a given sample, then "boil the fabric out in hot water," — boiling for several hours and then drying it. The difference in weight after drying and before boiling gives the weight of sizing material per sample piece.

6. If mineral loading has been used to a great extent, a large residue is left after burning.

Experiment 52 — Testing the Strength of Cloth

Apparatus: Dynamometer.
Materials: Various fabrics.
Reference: *Textiles*, page 678.

Directions

1. An excellent way to test the strength of a fabric is to place the two thumbs together and press them down on the sample, holding it tight underneath. Then try to break the threads, first in one direction and then in the other. Do they break easily? Notice whether one set is very much stronger than the other.

2. Manufacturers usually test yarn and fabrics by means of an instrument called a dynamometer. In this way one can find out whether a yarn or fabric comes up to the necessary strength, and

whether it has the required yield or stretch. Both these points are of importance in practical work, for it is essential that the yarn as shown should at least be strong enough to bear the strain of manufacture. The test is made by stretching a hank of yarn between the two hooks of a cloth testing machine. The handle at the side is now turned, so that the lower hook descends and puts a strain on the hank. This strain is increased, and at the same time the pointer moves around the dial, which indicates in pounds the amount of strain. When the threads of the hank begin to break, the strain is released, and the catch at the side keeps the pointer in position until the amount of strain is read on the dial. The distance stretched by the yarn before breakage occurs is shown in inches and fractions of an inch, in the small indicator arranged near the upper hook.

Test different fabrics and yarns.

Experiment 53 — Characteristics of a Knitted Fabric

Apparatus: Pick glass.
Materials: Knitted fabric, woven fabric.
Reference: *Textiles*, page 419.

Directions

1. Examine a piece of knitted fabric under the pick glass and notice the construction. How does it differ from weaving? The single thread is formed into rows of loops which hang upon each other, thus giving the knitted fabric its characteristic springiness. Why is hosiery suitable for underwear? Try to obtain the thread of the knitted fabric and reduce the whole to a heap of yarn by cutting it. Is the yarn intact?

2. A knitted fabric may be told from a woven fabric by studying the following sketch. (See page 733.)

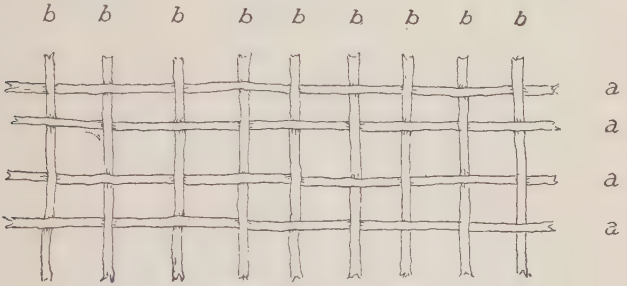
Note that the element of stretch or elasticity is wholly lacking in the woven cloth except what lengthwise elasticity may be in the threads themselves. On the other hand, referring to the printed diagram of the knitted fabric it will just as readily be seen that its very structure implies such a corrugation of its individual loops that if distended by force in any direction its tendency is to return to the normal.

The essential characteristics of good hose are:

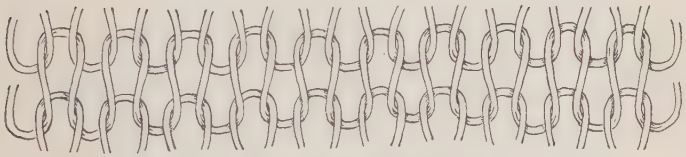
1. That they should be without seams.

2. That they should be so knit as to conform to the foot of the wearer.

3. That they should be thickened or reinforced where the greatest wear comes.



ORDINARY WEAVING
a. Weft. *b*. Warp.



PLAIN STOCKING FABRIC

The essential characteristics of good underwear are:

1. It should be made from elastic cloth, which implies a knitted cloth.

2. It should be porous in a high degree — whether in winter weight or summer weight.

3. The seams should be made upon the most modern sewing machines, with as little bulk as possible.

Experiment 54 — Experiment to Illustrate Imperfections in Hosiery

Apparatus: Magnifying glass.
Materials: Hosiery (seconds).
Reference: *Textiles*, page 427.

Examine a piece of hosiery called a *second*, obtained from a hosiery mill, and notice whether any of the following defects are present:

a. Yarn contains thick bits and buns.
b. Knots are badly tied.
c. Discolored yarn.
d. Lacks solidity and firmness, due to the gauge being too coarse for the yarn.
e. Full work-yarn too thick for gauge.

Experiment 55 — Characteristics of a Crochet Fabric

Apparatus: Crochet needle.
Material: Thread.

Directions

1. Crocheting is another method, like knitting, of making a fabric. Examine the operation of crocheting. Notice that only one thread is made use of, and is formed into loops by means of a large needle with a hook at the end. The chief point is that the loops are not formed in uniform rows, but one loop at a time, and with the greatest liberty to choose any part of the article already made to form a new loop. For this reason, crocheting adapts itself to the production of fancy patterns useful for ornamenting.

2. A knitted fabric can be told from a crocheted fabric by noting that a knitted fabric is composed of rows or ranks of loops of a single yarn which interlock successively with similar rows or ranks of loops, while a crocheted fabric consists of a structure the basis of which is a thread crocheted or knitted into a chain which is attached at intervals to itself.

Experiment 56 — Characteristics of a Good Piece of Cotton Cloth

Materials: Different samples of cotton fabrics.
Reference: *Textiles*, pages 252–253.

Directions

1. Examine different kinds of cotton fabrics. Compare the lowest, medium, and highest priced varieties of the same fabric.

Notice how quickly the finish of a low priced cotton fabric with a *thick* gloss loses its luster after washing.

2. Examine the different grades of the following fabrics: white lawn, Indian Head cotton suiting, muslin, lawn, and cambric Wash the samples several times.

Does it pay to buy cheap cotton fabrics for underwear, etc.?

What are the characteristics of a good piece of cotton cloth?

Experiment 57 — Characteristics of a Good Piece of Woolen Cloth

Materials: Different samples of woolens.
Reference: *Textiles*, pages 135–137.

Directions

1. Woolens differ from worsteds in having a more or less covered face, with the result that the weave rarely is noticeable, and the general color effects are much smoother and softer than those of worsteds.

2. Examine different grades of woolen fabrics, such as serges.

Defects. — If a piece of woolen is not constructed right from the start or if the work is not properly finished, that is, enough fulled in width or length, it is liable to be raggy or slazy. As a great many fabrics are more or less teaseled, there is a possibility of such pieces becoming too woolly and too hairy.

Experiment 58 — Characteristics of a Good Piece of Worsted Cloth

Materials: Different kinds of worsted fabrics.
Reference: *Textiles*, pages 135–137.

Directions

1. A good piece of worsted fabric should have a clear outline of the pattern, perfection of weave lines, and when the fabric is exposed to light should show a luster without polish.

2. Examine different types of worsted fabrics, and notice how many conform to the above requirements.

3. The most essential point of worsted is that it should have a clean

and even looking face. By clean is meant well sheared. By even is meant that the individual ends and picks used should be *even* and not full of knots, or of any foreign matter. Of course, there are some exceptions, for instance, in an unfinished worsted which has more or less nap on the face, it could not be sheared absolutely clear, but at the same time, the face should be very evenly cropped.

Defects. — A serious defect would be if the cloth was not well sheared or if it contained many uneven cords and picks, or ends and picks missing, or coarse ends and slubs.

Examine different worsteds and notice any defects.

Worsteds. — Speaking generally, worsteds may be divided into two classes, distinguishable according to the *luster* of their surface, or to the softness of their feel. They are used both for ladies' and men's wear. Worsted coatings may also be classed as worsteds. The coatings are woven in both single and double cloths in fancy weave effects for piece dyes, marketed in variety of finish, according to fashion.

Under this heading may be classified staple cloths, such as serges, clays, and fancy weave effects without any illumination. They can be finished in three ways: — Clear, undressed, and cheviot, used for ladies' dress goods or men's wear, according to weight.

The finish of the cloth varies according to the fashion, but there is always a certain demand for clear and undressed worsteds, for men's wear.

Examine a number of worsted fabrics and classify them.

Suitings. — The term *suitings* covers various manipulations of manufactured goods.

1. Tennis suitings, composed of all wool, or all worsted, white or cream ground, decorated with solid color, silk and weave stripe effects.

2. Piece-dyed worsteds, such as a blue ground with white silk line, cable cord, and fancy weave stripe effects, or any other ground shade color with its complementary decoration applied.

3. Mixture wool or mixture worsted yarns made into fabrics, decorations applied in color; cable, silk, and weave effects in stripes or overline color checks, suitable for men's wear, or decorated suitable for woman's wear. The darker shades for fall and the lighter shades for spring.

Experiment 59 — Characteristics of a Good Silk Fabric

Materials: Samples of different cheap silk fabrics.
Reference: *Textiles*, pages 312, etc.

There are cheap and expensive silk fabrics on the market. The consumer is often tempted to buy the cheaper fabric and wonders why there is such a difference in price. The difference in price is due to the cost of raw material and additional cost is due to the care in manufacturing. For example, raw silk costs from $1.35 to $5 a pound according to its nature, quality, and the country from which it comes. The cost of throwing silks preparatory to dyeing also varies, the average being 55 cents a pound for organzine or warp, and 33 cents a pound for tram and filling. The prices here also vary according to the nature of the twist imparted to the silk, which is regulated by the kind of cloth it is to enter into. The cost of dyeing varies from 55 cents a pound upwards to perhaps $1.50 a pound, according to the dye and the treatment which the silk is to receive in the process of dyeing. The cost of winding, quilling, and sundry labor items necessary with soft silk prior to its being woven, will perhaps average about a cent per yard of woven goods for the cheapest cloths and range upwards according to the grade of the fabric. The cost of weaving also varies with the cloth, and may be 9 cents for one fabric and 25 cents or more per yard for the more expensive.

Weavers are paid from 2 cents to 60 cents per yard for weaving the different fabrics, and other operations vary greatly in cost; for instance, the cost of printing is entirely dependent upon the work and the number of colors used, whether it is blotch printing, discharge work, or block printing. Different processes in finishing have widely varied costs. At the present time moire work is done which costs as high as 25 cents per yard. There are also other materials which can be finished for as little as $\frac{1}{2}$ cent per yard. Some goods have to be finished over and over again in the dyeing and finishing while others are very simply done. Many printed goods are handled 150 times after they come from the loom.

When it comes to relative values of similar goods produced by different manufacturers there are a few general principles by which

good construction can easily be determined. Most pure dye fabrics when burned will rather shrivel and boil than burn, while those which are weighted heavily with metallic salts will simply char and turn white without losing the structure of the fabric.

A fabric in which the quantity of warp and filling are of equal weight gives the maximum strength for the amount of material used. For the same weight and material, that having the most bindings of warp and filling will give the greater service. Fabrics with an insufficient number of warp or filling threads slide easily and do not give good service, though sometimes fashionable. A fabric having a twist in the warp and filling will last longer than one using the same amount of silk and the same binding with less twist.

All of these things may be taught to women many times over, but if the fashion demands an article which breaks all of the above laws and is everything that it should not be, they will buy it in preference to a serviceable fabric. As a general rule, the consumer will be safest in buying goods produced by houses of good reputation and whose products are well known.

A large part of the retail value of silk goods is their fashion demand and is quite independent of their cost of production. For instance, at the present time crêpe fabrics, brocades, and prints are commanding a premium while such goods as plain taffetas could not be sold for the cost of production.

The advantages of the better kinds of silks over the cheap ones are pure dye, long wear, and more expensive manufacturing.

Experiment 60 — How to Determine the Count of Yarn in Cloth

Material: Samples of fabrics.
Apparatus: Scales, ruler.
Reference: *Textiles*, pages 225–227.

The United States Government imposes a tax on certain imported fabrics and yarn. In the case of cotton, the rates of duty are to be ascertained according to the average number of the yarns in the condition in which it is imported.

The length of the yarn is to be counted as equal to the distance

covered by it in the cloth, all clipped threads to be measured as if continuous and all ply yarns to be separated into singles and the count taken of the total singles; any excessive sizing is to be removed by boiling or other suitable processes. The number of the yarn is the English number of 840 yd. to a lb. for a No. 1 yarn.

The average number of yarn may be found without unraveling the fabric, and is the quotient of the total thread length, by the weight in the proportion of 840 yd. of yarn equaling $8\frac{1}{3}$ grains, which is equivalent to a No. 1 yarn.

The following simple formula may be used:

Multiply the count of threads per square inch by the number of square inches in the sample used, this product to be multiplied by 100; then divide the product thus obtained by the weight of the sample in grains multiplied by 432. The quotient will give the number of the yarn.

For example, take a sample of cotton cloth 4 in. square, which equals 16 sq. in., having 28 warp and 28 woof threads, a total of 56 threads to the square inch, and weighing 8.6 grains. The formula applied would be as follows:

$$56 \times 16 \times 100 \div 8.6 \times 432 = 24, \text{ the number of the yarn.}$$

The formula may be further simplified by weighing a square yard of the cloth and dividing the number of threads per square inch by $\frac{1}{300}$ of the weight per square yard in grains.

Find the number of yarn in several cotton fabrics?

Experiment 61 — Study of Fabrics

A great deal of time should be devoted to the study of standard fabrics so that pupils may be able to recognize them by inspection and know how to test them for adulterants.

This may be done by having the pupils study the fabrics one by one, placing a sample of each in a note-book. Underneath the sample should be written the use of the fabric, the width, the different grades, with prices, wearing qualities, and how the fabric is made. In connection with this work special effort should be made to develop a textile vocabulary so as to be able to discriminate between the different fabrics, to know the types of weaves, and the different kinds of finish, etc. In this

way develop the ability to know what materials and colors weave best, the prices which should be paid for strong materials, the amount of material necessary, and the trade names of fabrics which can be depended upon for substantial goods.

Occasional tests in recognizing fabrics should be given by the teacher by placing before the pupils unlabeled fabrics that they have previously studied and have them give the name, approximate price or grade, weave, qualities, etc.

Remnants or small pieces of standard fabrics may be obtained from the leading dry goods stores of the country. Teachers should have on exhibition in cabinets a large display of standard fabrics with a card attached giving the name and use of each.

Experiment 62 — How to Examine a Fabric

The first thing a buyer of cloth notices in examining the fabrics is the finish. The finish is tested by feeling and seeing. To illustrate: broadcloth should have a smooth face and a nap evenly laid. If the finish is in keeping with the character of the cloth, he next examines the fiber of the yarn to see whether it is composed of pure wool or two or more fibers in combination.

Then test the strength of the cloth to see if it will meet the requirements.

A test should be made to tell whether it is poorly dyed or well dyed. There is no test that can be applied to all colors to ascertain this, neither is it possible to judge by the eye. The best way is to take a small sample of the goods and submit it to the washing and light test.

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